KING COUNTY CONVEYANCE SYSTEM IMPROVEMENT PROJECT

NORTH LAKE WASHINGTON PLANNING AREA

TASK 240 FINAL REPORT

ALTERNATIVES DEVELOPMENT

MARCH 2004

HDR

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INTRODUCTION AND SUMMARY

The King County Wastewater Treatment Division North Lake Washington Planning Area covers the nine service basins in King and Snohomish Counties that are upstream of the Kenmore and York Pump Stations. Besides King County, eleven local sewer districts operate and maintain conveyance lines and pump stations in this area. Figure 240-1 shows the location of the facilities.

The purpose of this report is to discuss the development of alternatives to address estimated future conveyance system capacity limitations in the planning area due to increasing populations and generated flows in the service area. This report includes population and employment forecasts and flow projections along with descriptions of the relevant methodology used to identify areas with capacity limitations. The forecasts are based on Puget Sound Regional Council forecasts using 2000 U.S. Census data, while the flow projections are based on the flow models developed and calibrated to the King County Regional Inflow/Infiltration program (2003 draft information).

The most extensive and immediate conveyance capacity limitations were identified in the North Creek Interceptor and Swamp Creek Trunks, with smaller, future limitations located along other pipelines. No capacity limitations were identified for the pump stations. Both the Kenmore and North Creek Pump Stations would be modified as part of the Brightwater Regional Wastewater Treatment System project.

Four principal methods were investigated to eliminate pipeline capacity limitations: pipeline replacement and/or parallel installation; pipe surcharging; inflow/infiltration (I/I) reduction, and constructing a storage facility. Pipeline replacement and/or parallel installation would be required for the existing limitations in a section of the Swamp Creek Trunk, a section of the Kenmore Interceptor Section 5, and two sections of the North Creek Interceptor. Surcharging limited sections of some pipeline by less than 1.3 feet would allow these pipelines to convey the 20-year peak hour flow in 2050 with little to no impacts to local systems. Implementing a I/I program with a 35 percent reduction in peak wet weather flow in some areas could potentially defer some future improvements by an additional 5 to 15 years. There were no cases in which the addition of peak flow wastewater storage facilities were recommended.

The planning-level alternatives recommended in this Task 240 report will be used as the basis for further refinement in the Task 250 report. The Task 250 report will include description of construction methods and costs.

PLANNING AREA DESCRIPTION

The North Lake Washington Planning Area covers 51,850 acres (81 sq. miles) of northern King County and southern Snohomish County. This area includes the following King County service basins:

- Swamp Creek – King
- Swamp Creek – Snohomish
- North Creek – King
- North Creek – Snohomish
- Bear Creek – King
- Cross Valley
- McAleer/Lyon
- Lyon
- Lake Ballinger – Snohomish
- Lake Ballinger – King
- Northwest Woodinville
- East Woodinville
- Bothell
- Inglewood
- Kenmore Section 5
- Lake Forest – Snohomish
- Lake Forest

The previous basins have local sanitary service provided by the following districts:

- Ronald Wastewater District (Ronald)
- City of Lake Forest Park (LFP)
- Northshore Utility District (Northshore)

- City of Bothell (Bothell)
- Woodinville Water District (Woodinville)
- City of Edmonds (Edmonds)
- City of Mountlake Terrace (MLT)
- Olympic View Water and Wastewater District (Olympic View)
- City of Brier (Brier)
- Alderwood Water & Wastewater District (Alderwood)
- Silver Lake Water District (Silver Lake)
- Cross Valley Water District (Cross Valley)

Figure 240-1 shows the boundaries of County's service basins, local utilities districts and major facilities and conveyance lines. Currently, King County provides conveyance of collected local wastewater to either the West Point or South Treatment Plants. In 2010, the Brightwater Treatment System becomes operational and all the North Lake Washington Service Basins upstream of the Kenmore Pump Station (PS) will be diverted to the new treatment plant.

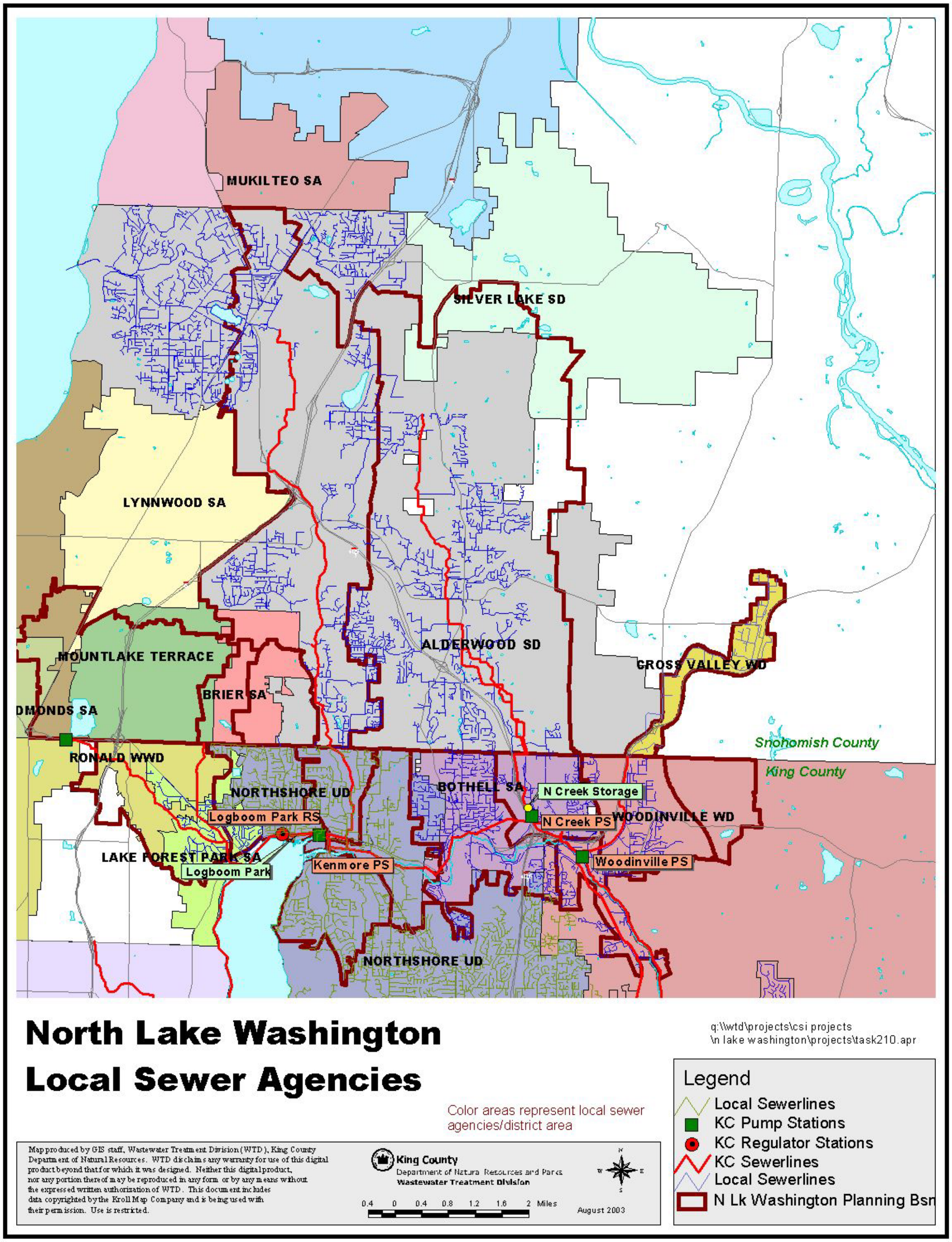

Figure 240-1. Local Sewer Agencies in the North Lake Washington Planning Area

Facilities Review

As outlined in the Task 220 report, the North Lake Washington Planning Area includes numerous King County facilities. The following major sewer lines convey flows through North Lake Washington:

- Lake Ballinger McAleer Trunk
- McAleer Trunk
- Lyon Creek Trunk
- Swamp Creek Trunk
- Inglewood Trunk
- North Creek Interceptor
- Bear Creek Trunk
- Bothell-Woodinville Interceptor
- Kenmore Interceptor Section 5
- Kenmore Interceptor Section 3

King County operates the following pump and regulator stations in the service area:

- Lake Ballinger PS
- Logboom Regulator Station (RS)
- Kenmore PS
- North Creek PS
- Woodinville PS

In addition, the 4-MG Logboom Storage Pipes and 6-MG North Creek Storage Facility are in the service area to provide protection against overflows. As mentioned previously, the Brightwater Treatment System will be operational in 2010. The treatment plant will be adjacent to State Route 9 in the Cross Valley Service Basin. The plant's influent pump station will be constructed in the vicinity north of the North Creek PS. A 6.3-mile, 11-foot diameter tunnel will be constructed from the Kenmore PS to the treatment plant. The tunnel will provide an additional 11-MG of storage to the North Lake Washington area. Flows will be diverted to the influent tunnel at the Kenmore PS, Manhole (MH) 99-18 of the Swamp Creek Trunk, and at the North Creek Diversion Structure (MH W85-01).

SERVICE POPULATION FORECASTS

Population forecasts for the North Lake Washington Planning Area have been developed by King County and by each of the local agencies that provide conveyance services to the area. The following section describes methodologies and forecasts used by the County and by the local agencies.

KING COUNTY METHODOLOGY AND FORECASTS

To identify future wastewater facility needs in its service area, King County projected future wastewater flows by first using population and employment forecasts provided by the Puget Sound Regional Council (PSRC). Population and employment forecasts were based on the 2000 census data and the 2000 commercial and industrial employment figures. PSRC provided forecasts for 1990, 2000, 2010, 2020 and 2030. King County extended this forecast through 2050 by applying a linear trend function, essentially assuming that growth would continue at the same rate until 2050, when the area would be expected to reach saturation for wastewater services. This section briefly describes the King County methodology. Additional information regarding the PSRC data and how King County uses the data for population forecasts can be found in Appendix 2-A, Population and Flow Analysis, of the Brightwater Final Environmental Impact Statement (EIS) (King County, 2003).

Forecast and Traffic Analysis Zones

The PSRC generates their data by allocating regional population and employment forecasts to small geographic areas called Forecast Analysis Zones (FAZs). FAZ boundaries are derived from census tracts. There are approximately 219 FAZs in the regional study area. The forecasts are then allocated to a finer zone structure or Transportation Analysis Zones (TAZ) for uses in the Council's travel demand models.

TAZs are Traffic Analysis Zones, which represent smaller areas than FAZs. PSRC initially forecasts population and employment by FAZ. After review and comment by local jurisdictions, the FAZ forecasts are revised and published. PSRC then develops forecasts for TAZs, which provides greater specificity on the location of current populations and forecasted growth. King County also uses the TAZ information to account for existing and future populations in the appropriate sewer service basins.

Population Estimate

Total population was calculated for residential, commercial, and industrial categories. It was assumed was made that 100 percent of the commercial and industrial employment populations contributed to the base sanitary flow, however, only a percentage of the total residential population contributed for the years prior to 2020 because all residential population is not sewered. The model assumed that for 2020 and beyond, all residential population within the particular Countywide Urban Growth Area would have sewer service.

To estimate the percentage land sewered for 1990, the King County sewered area map was overlaid on the service basin map. The sewered land areas within the basins were normalized to match PSRC acreages. The actual number of people on sewers per basin was unavailable and was estimated based on the percentage land sewered within each basin in conjunction with the types of land development as identified from aerial photos. The percent residential population and employment sewered between 1990 and 2020 was linearly interpolated such that all population and employment was 100 percent sewered by the year 2020. For 2020 and beyond, all residential population and employment were assumed to be 100 percent sewered.

The assumptions used in the population estimates and comparison of previous population forecasts with the current forecasts can be also be found in the Brightwater Final EIS Appendix 2-A.

ALDERWOOD WATER AND WASTEWATER DISTRICT

Alderwood population estimates were developed by the Snohomish County POPUL model. The POPUL model uses PSRC FAZ and U.S Census data to divide and reaggregate the data to conform to 16th section survey areas. Reaggregating the data into the smaller areas allows the POPUL model to make more refined future populations forecasts in specific sub-county areas, such as the Alderwood service area. Afterwards, population and employment data were analyzed to determine current growth trends which were then applied to a linear extrapolation algorithm to generate the forecasts. For the Alderwood service area, the annual average growth rate used for the forecast is 2.56 percent, which was the historical annual growth rate from 1900 to 1997. Table 240-1 lists the projected residential populations at buildout at 2012. No similar data was published for the commercial or industrial populations.

Table 240-1. Alderwood Water & Wastewater District Buildout Residential Populations

Buildout Residential Population[1]	Alderwood Swamp Creek Basin	Alderwood North Creek Basin	Alderwood Bear Creek Basin[2]
In existing service area	71,758	85,444	0
In potential sewer service area	1,521	5,111	125
Potential total residential population	73,279	90,555	125

1: Buildout assumed to be 2012.
2: Corresponds to portion of King County Cross Valley Basin

Source: 2000 Alderwood Water & Wastewater District Sanitary Sewer Comprehensive Plan – Vol. 1

CITY OF BOTHELL

The PSRC data was also used as the basis for Bothell's future population estimates. Bothell listed the following assumptions and estimates in the *1993 City of Bothell Sanitary Sewer Plan* to develop their forecasts:

- Total estimated existing sewer basin acreage in 1993 is 2,045 acres, of which 409 acres is undevelopable.
- Total estimated future sewer basin acreage by 2010 is 3,581 acres, of which 716 acres is undevelopable.
- Average density within existing and future basins is 3 dwelling units (DU) per acre.
- The approximate 1,229 acres available for development will be developed between 1991 and 2000 at an average rate of 139 acres/year.

Table 240-2 lists the forecasted populations within the Bothell service area.

Table 240-2. City of Bothell Sewer Service Population Forecasts

Year	Estimated Dwelling Units	Number of People per Dwelling Unit*	Estimated Population	Percent Increase in Population
1990	4,908	2.58	12,663	Not applicable
1995	5,523	2.53	13,973	10.3% from 1990 to 1995 (2.1% per year)
2000	6,138	2.47	15,160	8.5% from 1995 to 2000 (1.7% per year)
Note: Value is for single family residential areas. Multi-family residential and trailer areas used constant values of 1.60 people/DU and 2.58 people/DU, respectively. Source: 1993 City of Bothell Sanitary Sewer System Plan				

CITY OF BRIER

The U.S. Census recorded that Brier had a population of 5,633 people in 1999 while the City recorded a population of 6,365 people in 2000. The population growth rate was then calculated to be an average annual increase of 1.25 percent over those ten years. This growth rate was used in conjunction with land use estimates from Brier's Land Use Comprehensive plan to develop an estimate of 8,171 people by 2020 and 9,777 people at buildout in 2035. The current and buildout conditions are listed in Table 240-3.

Table 240-3. Values used for City of Brier Population Forecasting

Parameter	Value
Total residential area in 1998	1,207 acres
Average residential density	2.7 DU/acre
Buildout residential density	3.0 DU/acre
Source: 2000 Draft City of Brier Comprehensive Sewer Plan.	

CITY OF LAKE FOREST PARK

In the *1999 City of Lake Forest Park Comprehensive Sewer Plan*, LFP estimated the sewered population in the service area was 4,433 people in 1997. Since LFP does not anticipate further expansion of the service area, land use changes, or significant growth within the current sewer area, the city used an average annual population growth rate of 0.42 percent to the year 2018 (4,751 people), the extent of the population forecast.

In January 2003, LFP acquired the portions of the Ronald service area within the LFP city limits. The acquisition increased the service population by 2,325 people. The former Ronald sewered area is located in both the McAleer/Lyon Service Basin and the Matthews Park Service Basin. The population in the acquired area was not subdivided into smaller areas to assist in determining what portion of the 2,325 people would be in the McAleer/Lyon Service Basin and therefore in the North Lake Washington Planning Area. No future population or growth rates were assigned to this area. Ronald considered this area to be built-out, so this report assumed the future growth rate for the acquired area to be the same as the rest of LFP.

CROSS VALLEY WATER DISTRICT

As with Alderwood, Cross Valley population forecasts were obtained from the Snohomish County POPUL model. Cross Valley's sewer planning area population is expected to increase from an estimated 6,540 people in 1992 to 11,095 people in 2012, with the highest population growth occurring west of State Route 9 (*1998 Cross Valley Water District Sewer System Comprehensive Plan*).

NORTHSHORE UTILITY DISTRICT

Northshore population projections were estimated using TAZ population projections provided by PSRC along with land use data from the local jurisdictions served by Northshore. Future sewered populations were determined by assuming that 100 percent of the population within the Northshore sewer service area would be connected by 2020. Forecasts between 2000 and 2020 were determined by linearly extrapolating values for percent sewered and applying to the TAZ population forecast. Northshore estimates that the sewered population would increase from 64,243 in 1999 to 82,609 by 2020 (*2000 Northshore Utility District Wastewater Comprehensive Plan – Volume 1: System Analysis and Capital Improvements*).

CITY OF EDMONDS, OLYMPIC VIEW WATER AND WASTEWATER DISTRICT, CITY OF MOUNTLAKE TERRACE

The portions of the Edmonds, Olympic View, and MLT local systems located in the North Lake Washington Planning Area are located in the Lake Ballinger – Snohomish Service Basin and are conveyed to the Lake Ballinger PS. Due to the interlocal agreements between Olympic View and MLT with Edmonds, and Edmonds with King County, the Edmonds Flow Transfer Agreement governs the current and future flows from these agencies and therefore, no analysis of population projections for these agencies is required.

RONALD WASTEWATER DISTRICT

With the service area transfer to LFP, the remaining portion of Ronald in the North Lake Washington Planning Area is in the Lake Ballinger – King Service Basin, which drains to the Lake Ballinger PS. Flows from Ronald are governed by the Edmonds Flow Transfer Agreement due to interlocal agreements between Ronald and MLT, and MLT with Edmonds. Therefore, analysis of the Ronald service population is not required.

SILVER LAKE WATER DISTRICT

Population projections for Silver Lake were based on results from the POPUL model. The projections estimated that the sewered population would grow at an average annual growth rate of 4.87 percent between 1998 and 2012, and a rate of 3.57 percent between 2013 and 2026. Silver Lake assumes that the total population within its service area is sewered by 2026.

Table 240-4 lists the projected total and sewered populations in Silver Lake. Note, the populations listed include both the portion of the district in the North Lake Washington Planning Area and the portion that served by the City of Everett. No population breakdown by service provider was included in the comprehensive plan.

Table 240-4. Projected Silver Lake Water District Populations

Year	Total Population	Sewered Population
1996	25,534	19,923
2000	30,436	25,607
2010	42,689	39,818
2020	57,819	56,756
2026 (Buildout)	67,328	67,328
Source: 1998 Silver Lake Water District Wastewater Comprehensive Plan Update		

WOODINVILLE WATER DISTRICT

The *1993 Woodinville Water District Comprehensive Sewer Plan* indicated that the total residential populations within the Woodinville service area in 1993 were estimated to be 10,780 people. By buildout, the residential population would have grown to 36,053. The plan did not indicate what the sewered populations were, what the anticipated growth rates are, or when buildout conditions would be achieved. However, the report did show the capital improvement plan ending in 2004.

FLOW PROJECTIONS

Flow projections for the North Lake Washington Planning Area have been developed by King County and by each of the local agencies that provide conveyance services to the area. Each of the various agencies based their flow projections on current and forecasted populations in their respective areas. However, each agency used different methodologies and assumptions for the flow projections. In addition, the values used to estimate the production of wastewater varied for each of the cities and counties. These values were either obtained from known existing flows in each agency's respective conveyance system or from estimates previously developed by the County. The peaking factor associated with the wastewater production also differed between the agencies. These differences have resulted in local agency flow projections that do not necessarily correspond with the County flow projections.

The details regarding each agency's specific flow projection methodology are described below. The summary section will compare the local agency projections with those of the County and will account for any variations.

KING COUNTY METHODOLOGY AND FORECASTS

In general terms, the method used for converting forecasted population and employment data to wastewater flow projections was to multiply population forecasts by unit flow factors representing average volumes of wastewater generated per person or employee, yielding a "base" wastewater flow. Table 240-5 lists the categories and unit flow factors used by King County. More information regarding how the categories and unit flow factors were determined can be found in Appendix 2-A of the Brightwater Final EIS.

Table 240-5. King County Unit Flow Factors

Population Category	Unit Flow Factor
Residential Seattle	56 gpcd
Residential Non-Seattle	66 gpcd
Commercial	33 gped
Industrial	55 gped

Notes: gpcd = gallons/capita/day; gped = gallons/employee/day

Source: Appendix 2-A, Population and Flow Analysis, Brightwater Final Environmental Impact Statement (King County, 2003).

Modeled I/I was added to the base flow to obtain King County's design flow from a 20-year flow event. The I/I values were location-specific and were developed from the comprehensive King County I/I monitoring program. Refer to Appendix 2-A of the Brightwater Final EIS for additional information regarding the development of the I/I data.

ALDERWOOD WATER AND WASTEWATER DISTRICT

Alderwood developed the unit flow factors using specific land use classifications as a function of land use classifications (see Table 240-6). Base flow estimates for each of Alderwood's five sewer basins were developed by multiplying the area of each land use category with the respective until flow factor and population density. In addition, Alderwood has six permitted industrial discharges within its service area. The average flows of each of these industrial discharges and the location of the discharges in the County service basins are listed in Table 240-7.

A wet weather infiltration flow factor of 225 gpad was applied to the entire Alderwood service area. This flow factor is based upon flow measurements obtained at the Alderwood Picnic Point Wastewater Treatment Plant. The 5-year peak wet weather I/I flow factor (which includes the wet weather infiltration flow factor) was estimated to be 1,800 gpad and 1,225 gpad for the Alderwood Swamp Creek and North Creek basins, respectively. These values were developed for Alderwood by King County in the *1999 Regional Wastewater Services Plan* using a hydraulic model calibrated with measured flows in the Swamp Creek Trunk and through the Kenmore PS.

Table 240-6. Alderwood Water and Wastewater District Unit Flow Factors

Land Use	Population Density (DU/acre)	Unit Flow Factor
RR	0.5 DU/acre	256 gpd/DU
UR-1 Residential	3 UD/acre	223 gpd/DU
UR-2	5 DU/acre	188 gpd/DU
UR-3	11 DU/acre	142 gpd/DU
COM and IND	Not applicable	1,200 gpad
Notes: DU = dwelling unit; gpad = gallons/acre/day Source: 2000 Alderwood Water & Wastewater District Sanitary Sewer Comprehensive Plan – Volume 1.		

Table 240-7. Industrial Discharges in the Alderwood Water and Wastewater District

Discharger	Average Daily Flow (gpd)	King County Service Basin
Lynnwood Plating	3,000	Swamp Creek
Eldec North Creek	4,200	North Creek
Eldec Martha Lake	3,500	Swamp Creek
ATL Ultrasound	2,700	North Creek
Circuits Engineering	13,000	North Creek
Immunex	21,000	North Creek

CITY OF BOTHELL

Table 240-8 lists the flow factors of used by Bothell to develop their respective flow estimates. Bothell did not develop any estimates for specific point flows from large manufacturing facilities or buildings apart from the schools and churches. Flow estimates were developed by multiplying the size of various land use areas (i.e. single family residential, commercial, schools, etc) with the appropriate flow factor and then summing the values for each of Bothell's nine major sewer basins.

CITY OF BRIER

Brier used the values in Table 240-9 to develop wastewater flow projections. I/I flow is derived from an area value. Residential unit flow factors were estimated from results generated from the 1993 Brier I/I Study. The calculated flows were then compared against flow measurements obtained from the Brier Golden View Pump Station. Unit flow factors for schools, commercial areas, and libraries flow values were obtained from the Washington State of Department of Ecology's *Criteria for Sewage Works Design* ("Orange Book"). The populations for these areas were either obtained from school district records or information for Brier's Land Use Comprehensive Plan.

Table 240-8. City of Bothell Unit and I/I Flow Factors

Factor	Value
Per capita domestic flow	100 gpcd
Commercial wastewater flow	800 gpad
Elementary schools (average of 600 people) wastewater flow	16 gpcd
Junior/Senior high school (average of 1,200 people) wastewater flow	16 gpcd
Business/office wastewater flow	25 gpcd
Churches (average of 200 seats)	4 gallons/seat
Peaking factor	2.5
Groundwater infiltration	600 gpad
Stormwater inflow	500 gpad
Source: 1993 City of Bothell Sanitary Sewer System Plan	

Table 240-9. City of Brier Flow Factors

Factor	Value	Notes
Per capita domestic flow	80 gpcd	
Average population density	3.1 people/ERU	
Household density	2.6 - 3.0 ERU/acre	
Average wastewater flow	248 gpd/ERU	
Peaking Factor	2.5	
I/I flow	600 gpad	
Peak middle school wet weather flow	13,600 gpd	Assumed 850 people at 16 gpcd
Peak elementary school wet weather flow	6,150 gpd	Assumed 615 people at 10 gpcd
Peak commercial wastewater flow	5,000 gpd	Assumed 100 people at 50 gpcd
Peak library wastewater flow	250 gpd	Assumed 50 people at 5 gpcd
Note: ERU = equivalent residential unit Source: 2000 Draft City of Brier Comprehensive Sewer Plan.		

CITY OF LAKE FOREST PARK

Table 240-10 details the flow factors included in the *1998 Draft City of Lake Forest Park Comprehensive Sanitary Sewer Plan*. The wastewater unit flow factor was obtained from the 1979 King County Sewerage General Plan. The Orange Book unit flow factor for schools was multiplied by the number of enrolled students and employees at the local elementary school to obtain the elementary school flow. The flow from the shopping center was estimated by determining the largest monthly potable water consumption bill from the period between 1996 and 1997 and then assuming that 80 percent of all potable water used becomes wastewater.

Table 240-10. Lake Forest Park Unit Flow Factors

Factor	Value	Notes
Per capita domestic flow	85 gpcd	From 1979 King County Sewerage General Plan
Average population density	2.4/ERU	
Average residential flow	204 gpd/ERU	
Average elementary school flow	26,400 gpd	Assumed 550 people at 10 gpcd
Average shopping center flow	45,200 gpd	Based on 80 percent of potable water consumption
Peaking factor	3.0	
I/I flow	1,100 gpad	
Source: 1998 Draft City of Lake Forest Park Comprehensive Sanitary Sewer Plan		

CROSS VALLEY WATER DISTRICT

The unit flow factors used by Cross Valley to develop future flow estimates are listed in Table 240-11. These factors were developed using information obtained from King County, the Orange Book, historical Cross Valley water records, and the American Society of Civil Engineer's *Manual of Engineering Practice No. 37 – Design and Construction of Sanitary and Storm Sewers*. The unit flow factor for the University of Washington (UW) Branch Campus was obtained from the *1990 University of Washington Campus Site Selection Final Environmental Impact Statement*. The UW eventually constructed the branch campus in Bothell, so peak flows listed in the Cross Valley report will not be achieved.

Table 240-11. Cross Valley Water District Unit Flows

Factor	Value
Average population density	2.6/ERU
Per capita domestic flow	85 gpcd
Industrial/commercial	1,800 gpad
Peaking factor	2.5
UW Branch Campus	16 gpcd
I/I flow	800 gpad
Source: 1998 Cross Valley Water District Sewer System Comprehensive Plan.	

NORTHSHORE UTILITY DISTRICT

The unit factors used by Northshore to estimate the future flows are Table 240-12. Per capita domestic flow was calculated by obtaining 1998 Northshore potable water consumption data and assuming that 83 percent of all potable water used becomes wastewater; the remainder is assumed to be used for home irrigation. For the non-residential unit flow factor, the wastewater flow was equal to be approximately equal to the average potable water consumption in Northshore for November and December 1998. The peak I/I flow factor of 1,100 gpad is based on information provided by King County. However, Northshore I/I flow monitoring indicates that I/I flow is less than 500 gpad.

Table 240-12. Northshore Utility District Unit Flows

Unit Factor	Value
Per capita domestic flow	74 gpcd
Non-residential flow	600 gpad
I/I flow	1,100 gpad
Residential peaking factor	2.5
Non-residential peaking factor	2.8
Source: 2000 Northshore Utility District Wastewater Comprehensive Plan – Volume 1: System Analysis and Capital Improvements	

SILVER LAKE WATER DISTRICT

The unit factors used by Silver Lake to estimate the future flows are Table 240-12. Per capita domestic flow was calculated by obtaining Silver Lake winter 1995-1996 potable water consumption data and assuming that 80 percent of all potable water used becomes wastewater; the remainder is assumed to be used for home irrigation. The per capita domestic unit flow factor was assumed to be constant for the duration of the study. The peaking factor data was obtained from the *1998 South Everett Sanitary Sewer System Comprehensive Plan*. The South Everett data indicated that the peaking factor decreased as base flows increased. The 1995 I/I flow was determined from analysis of Silver Lake flow monitoring data and then increased at a linear rate to a maximum I/I flow of 1,000 gpad at buildout in 2026.

Table 240-13. Silver Lake Water District Unit Flow Factors

Factor	Value by Year		
	1995	2012	2026
Per capita domestic flow	60 gpcd	60 gpcd	60 gpcd
Peaking factor	2.48	2.30	2.20
I/I flow	100 gpad	850 gpad	1,000 gpad

WOODINVILLE WATER DISTRICT

Table 240-14 lists the unit flow factors used by Woodinville. Review of Woodinville records from the winter of 1991 to 1992 indicated that the potable water consumption was between 50 to 110 gpcd, with a weighted average of 73 gpcd. The conservative wastewater unit flow value used by Woodinville assumed that irrigation was minimal and a 10 percent increase in future potable water use. Winter-time flow measurements indicated that the weighted average non-residential sanitary flows for Woodinville were 352 gpad. However, the King County Sewerage General Plan indicated that flows from light industrial areas are typically 2,000 gpad. Though Woodinville water records did not support such a high flow, the wastewater flow model assumed a conservative value of 1,000 gpad for the non-residential areas. The peaking factor used by Woodinville varied by year as a reflection of the base flow, with increasing base flows resulting in lower peaking factors. The Woodinville peaking factor/base flow curve was obtained from the American Society of Civil Engineer's *Design and Construction of Sanitary and Storm Sewers* (1979).

Table 240-14. Woodinville Water District Unit Flow Factors

Factor	Value
Per capita domestic flow	80 gpcd
Non-residential flow	1,000 gpad
I/I flow	1,200 gpad

SUMMARY OF SERVICE POPULATIONS FORECASTS AND FLOW PROJECTIONS

Table 240-15 is a summary of the estimated 2000 and build-out (2050) populations for each of the service basins in the North Lake Washington Planning Area. The principal variations between the County's forecasts and those listed previously for the local agencies are that 1) King County used the latest PSRC and U.S. Census data while the local agency forecasts were produced using datasets prior to 2000 Census, 2) portions of the service areas for Northshore, Alderwood, and Silver Lake are outside of the North Lake Washington Planning Area, and 3) King County forecasts extended to 2050 while the local agency forecasts ended between 2000 and 2035. Once the local agency forecasts are adjusted using the latest PSRC data and extended to 2050, and the areas outside of the North Lake Washington Planning Area were excluded, the differences in future service populations were minor.

Table 240-16 shows the projected flows for each of the King County basins. Once the population differences were reconciled, the differences between County's and the local agency's flow projections are due to the differences in the unit flow factors and the I/I flow factor, with the I/I flow factor being the more important value when determining the capacity of the King County system to convey the 20-year peak hour flows. Both the King County unit flow and I/I flow factors were developed from the Regional I/I study using a model calibrated with flow meter data. The differences in County and local agency flow forecasts are also minor when the County flow factors are used in the local agency model.

As mentioned earlier, Appendix 2-A, Population and Flow Analysis, of the Brightwater Final EIS, has a more detailed discussion regarding the County's methodology in forecasting future populations and projecting future flows in the North Lake Washington Service Area.

Table 240-15. Summary of King County Populations Projections

King County Basin	2000					2050			
	Total RES	Sewer RES	COM	IND	Total Sewer	Sewer RES	COM	IND	Total Sewer
Swamp Creek – Snohomish	40,328	25,382	8,376	5,011	***38,769***	37,269	14,967	52	***52,288***
Swamp Creek – King	3,837	3,387	1,128	38	***4,553***	5,691	2,319	9	***8,019***
North Creek – Snohomish	54,934	40,360	12,490	4,777	***57,627***	140,072	35,755	5,842	***181,669***
North Creek – King	3,198	2,726	3,952	1,045	***7,723***	5,043	5,810	87	***10,940***
Cross Valley	310	132	641	563	***1,336***	788	1,824	887	***3,499***
Bear Creek – King	4,806	3,985	5,638	2,251	***11,874***	7,239	9,799	1,290	***18,328***
Lyon	2,804	2,151	160	1	***2,312***	5,225	362	4	***5,591***
Lake Ballinger – Snohomish	24,546	19,513	9,077	321	***28,911***	108,137	25,440	6,140	***139,717***
Lake Ballinger – King	5,129	4,216	1,774	11	***6,001***	4,568	2,124	84	***6,776***
McAleer/Lyon	14,430	13,487	2,114	41	***15,642***	17,220	4,373	15	***21,608***
Northwest Woodinville	2,170	1,921	1,442	761	***4,124***	2,733	2,187	531	***5,451***
East Woodinville	2,093	757	1,562	515	***2,834***	2,956	2,835	347	***6,138***
Bothell	11,312	9,633	3,733	85	***13,451***	16,142	5,412	17	***21,571***
Inglewood	6,469	5,900	1,068	0	***6,968***	7,892	2,113	0	***10,005***
Kenmore Section 5	4,102	3,335	1,212	34	***4,581***	5,384	2,375	77	***7,836***
Lake Forest – Snohomish	3,662	2,701	170	4	***2,875***	7,728	454	10	***8,192***
Lake Forest	7,165	6,836	895	23	***7,754***	8,658	1,831	53	***10,542***
Total	***191,295***	***146,422***	***55,432***	***15,481***	***217,335***	***382,745***	***119,980***	***15,445***	***518,170***

Notes:
Total RES = total residential; Sewer RES = sewered residential (by 2050, Total RES = Sewer RES); COM = commercial; IND = industrial

Table 240-16. Summary of Flow Projections in North Lake Washington Planning Area

King County Basin	2050 Peak (mgd)
Swamp Creek – Snohomish	27.3
Swamp Creek – King	7.5
North Creek – Snohomish	38.6
North Creek – King	1.7
Cross Valley	1.7
Bear Creek – King	5.9
Lyon	4.6
Lake Ballinger – Snohomish	23.2
Lake Ballinger – King	5.8
McAleer/Lyon	5.0
Northwest Woodinville	2.1
East Woodinville	2.7
Bothell	11.6
Inglewood	2.7
Kenmore Section 5	4.0
Lake Forest – Snohomish	2.6
Lake Forest	14.5

SYSTEM EVALUATION

The evaluation of the County's conveyance system in the North Lake Washington Planning Area was conducted by the County's modeling team using projected preliminary draft base and 20-year peak hour I/I flow data obtained from King County. As described earlier, base flow data were obtained by multiplying unit flow factors with forecasted population and employment data provided by PSRC, while I/I flows were developed from information provided by the King County I/I program. Descriptions regarding the population and employment forecasts and the I/I flow projections are available in Appendix 2-A of the Brightwater Final EIS.

The flow data was provided for model basins, which are subareas of the planning basins. Flow from the model basins entered into the conveyance system was select manholes for each pipeline. For some basins, the entire flow from the model basin entered the conveyance system at one point while other basins had the flows enter the system at multiple manholes, each with different fractions of the total basin flow. Figure 240-2 shows the modeling basins.

For this evaluation, it was assumed that basin boundaries flow input points, and the fraction of model basin flow at each flow input point remained constant over the duration of the evaluation. The maximum potential benefits of I/I reduction were estimated to 35 percent of the 20-year peak hour I/I flow for a given decade.

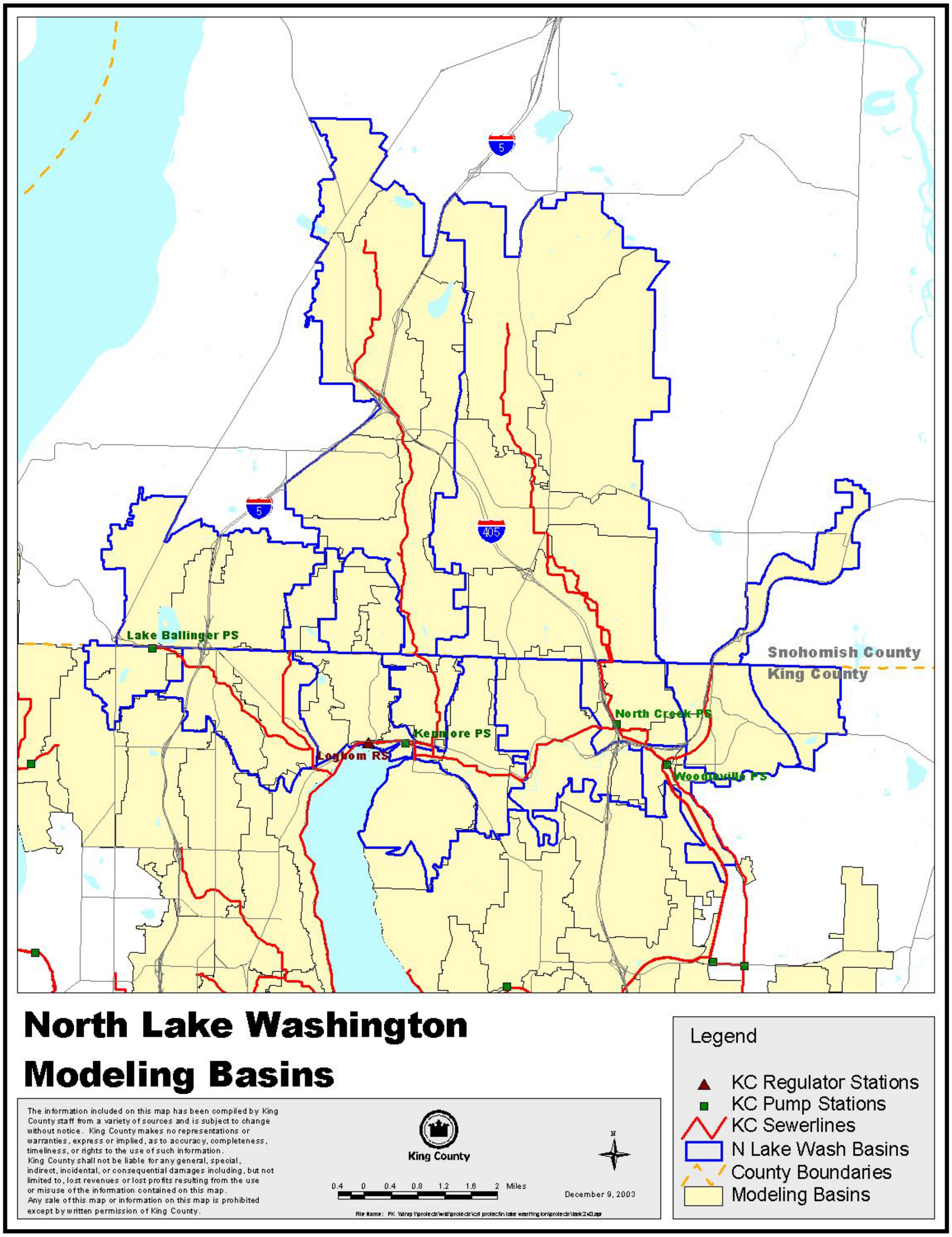

Figure 240-2. North Lake Washington Modeling Basins

LITTLE BEAR CREEK TRUNK

The model basins used for the evaluation of the Little Bear Creek Trunk and their respective flow percentages and input locations are listed in Table 240-17.

Table 240-17. Modeling and Flow Inputs to Little Bear Creek Trunk

Model Basin	Percentage of Total Basin Flow	Input Location	Notes
M_CRV003	100	MH W11-A32	Connection with Cross Valley Bear Creek Trunk
M_LBEARA03	32	MH W11-A18	
	68	MH W11-A05	

Figure 240-3 shows the existing capacity of the trunk as well as the projected future flows that enter the trunk. As indicated in the figure, this conveyance pipeline is adequately sized to convey the projected 20-year peak hour flows from now to saturation in the year 2050. I/I reduction would not provide any benefit to this part of the County conveyance system but may delay the need for capital improvements in downstream facilities.

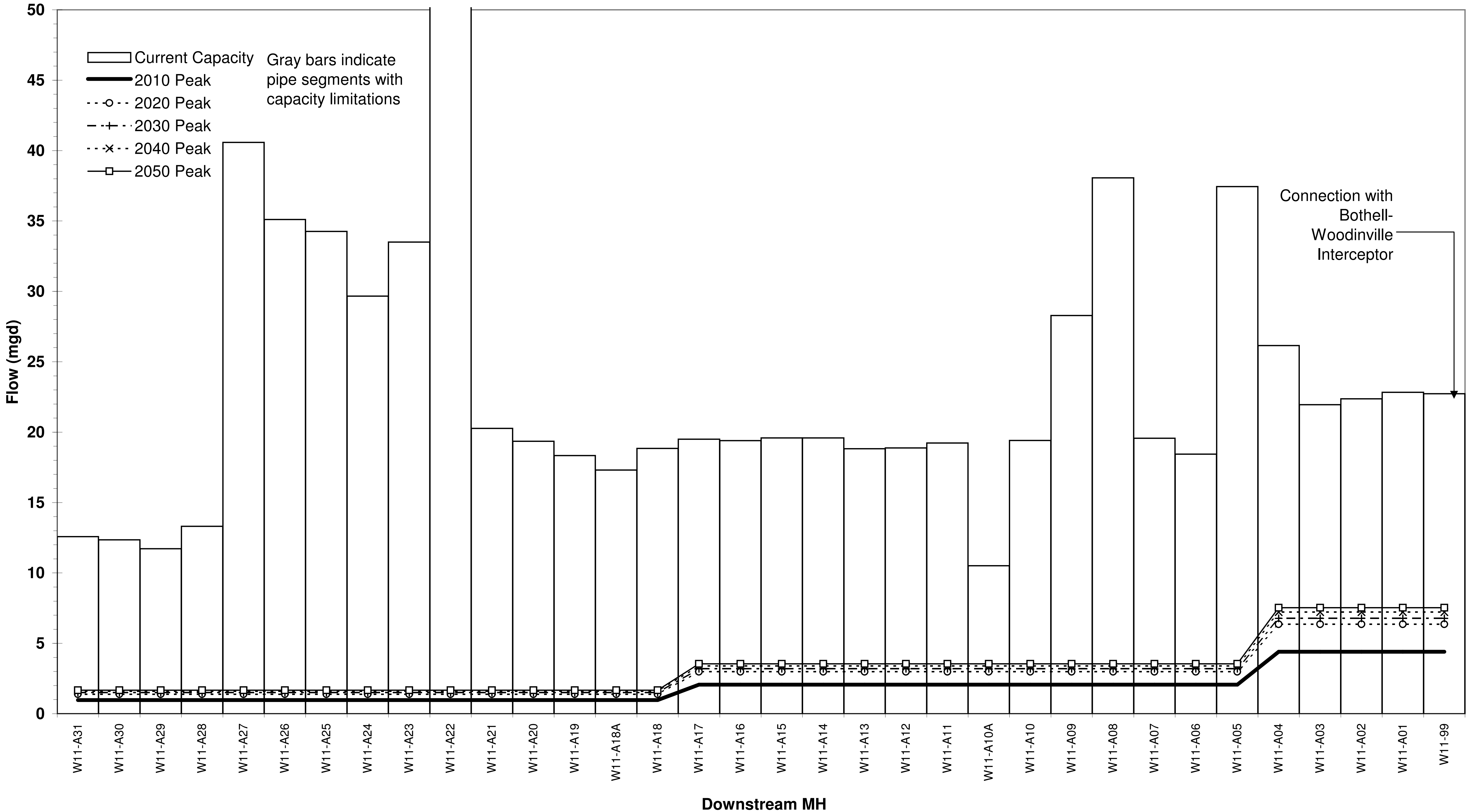

Figure 240-3. Existing Capacity and Projected Future Flows in the Little Bear Creek Trunk

NORTH CREEK INTERCEPTOR

The model basins used for the evaluation of the Little Bear Creek Trunk and their respective flow percentages and input locations are listed in Table 240-18.

Table 240-18. Modeling and Flow Inputs to North Creek Interceptor

Model Basin	Percentage of Total Basin Flow	Input Location	Notes
M_ALD	76	MH 76-1.56	Connection with Alderwood Penny Creek Trunk
	24	MH 76-1.03	
M_ALD011	100	MH 69-2.57F	Connection with Alderwood Olympus Meadows Trunk
M_ALD001	25	MH 69-2.57D-1	
	17	MH 69-2.57A	
	13	MH 69-2.57	
	24	MH 69-2.53	Connection with Alderwood Queensborough Interceptor
	21	MH 68-1.46	
N_NCREK012	55	MH 68-1.41	
	25	MH S3-89.08	
	10	MH S3-89.04	
	10	MH W85-13	
M_NCREK001	100	MH W85-08	
M_BOT009	100	MH W85-01	

Existing Capacity and Projected Future Flows

The North Creek Interceptor consists of the three distinct sections: the northern most section upstream of the Flow Diversion Structure, a section of two parallel pipes downstream of the Flow Diversion Structure, and the section in King County that brings the flows in the two parallels together before discharging to the planned Brightwater North Creek Diversion Structure. This section will discuss the conveyance capacities and projected flows in each section of the North Creek Interceptor.

North Creek Interceptor Upstream of the Flow Diversion Structure
Figure 240-4 shows the existing capacity and projected future flows of the North Creek Interceptor upstream of the Flow Diversion Structure. There are three reaches in the pipe that have insufficient capacity to convey the 20-year, 24-hour peak flows in the year 2050. The locations of these three reaches are listed in Table 240-19 and shown in Figure 240-5.

Table 240-19. Conveyance Capacity Limitations in North Creek Interceptor Upstream of Flow Diversion Structure.

Upstream MH	Downstream MH	Pipe Length (feet)	Pipe Diameter (inches)	Year Capacity is Exceeded
76-1.41	76-1.35	1,650	24	2030
76-1.03	76-1.02	230	24	2035
69-2.57F	1-69.A25	6,430	24	Prior to 2010

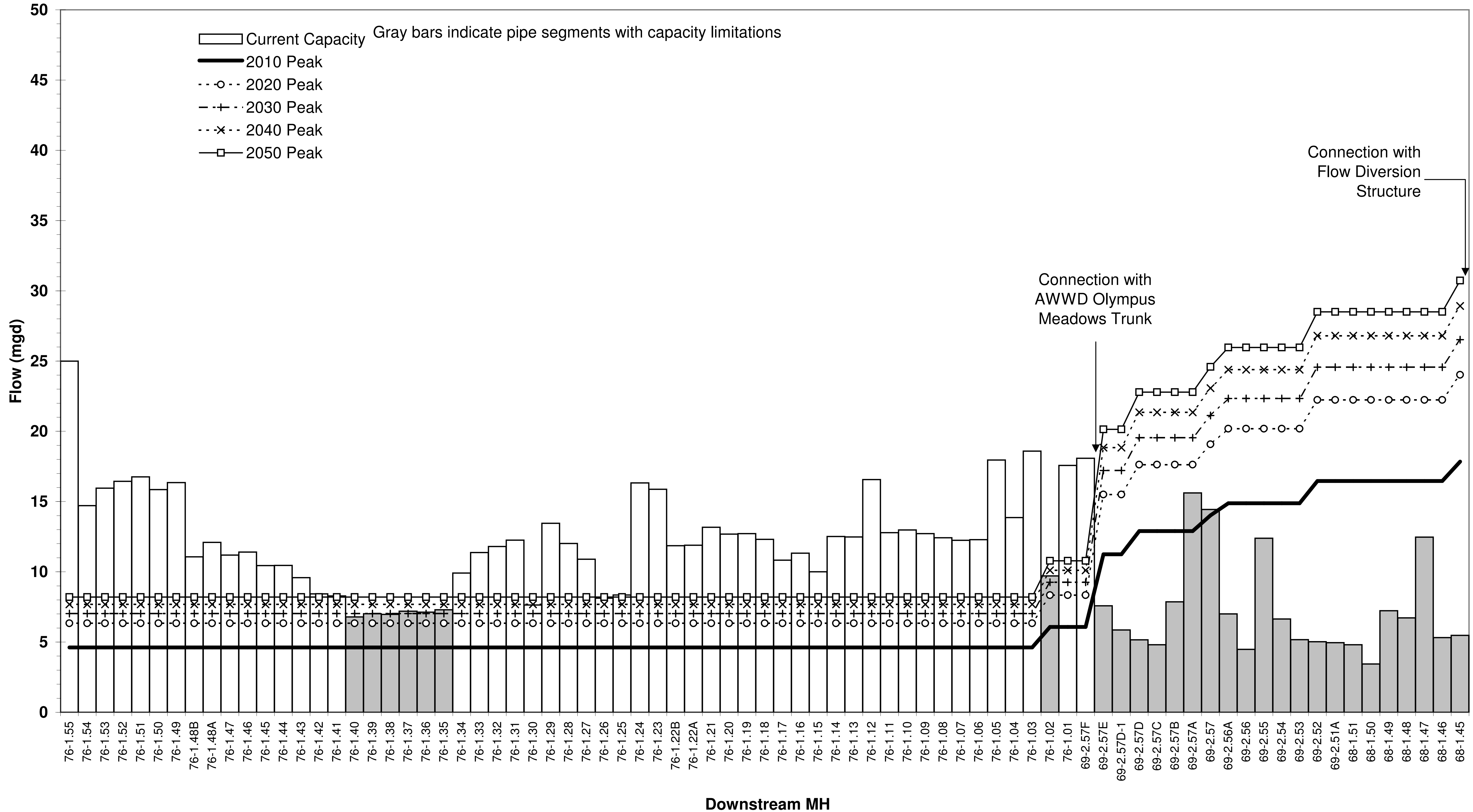

Figure 240-4. Existing Capacity and Projected Future Flows in the North Creek Interceptor Upstream of Flow Diversion Structure

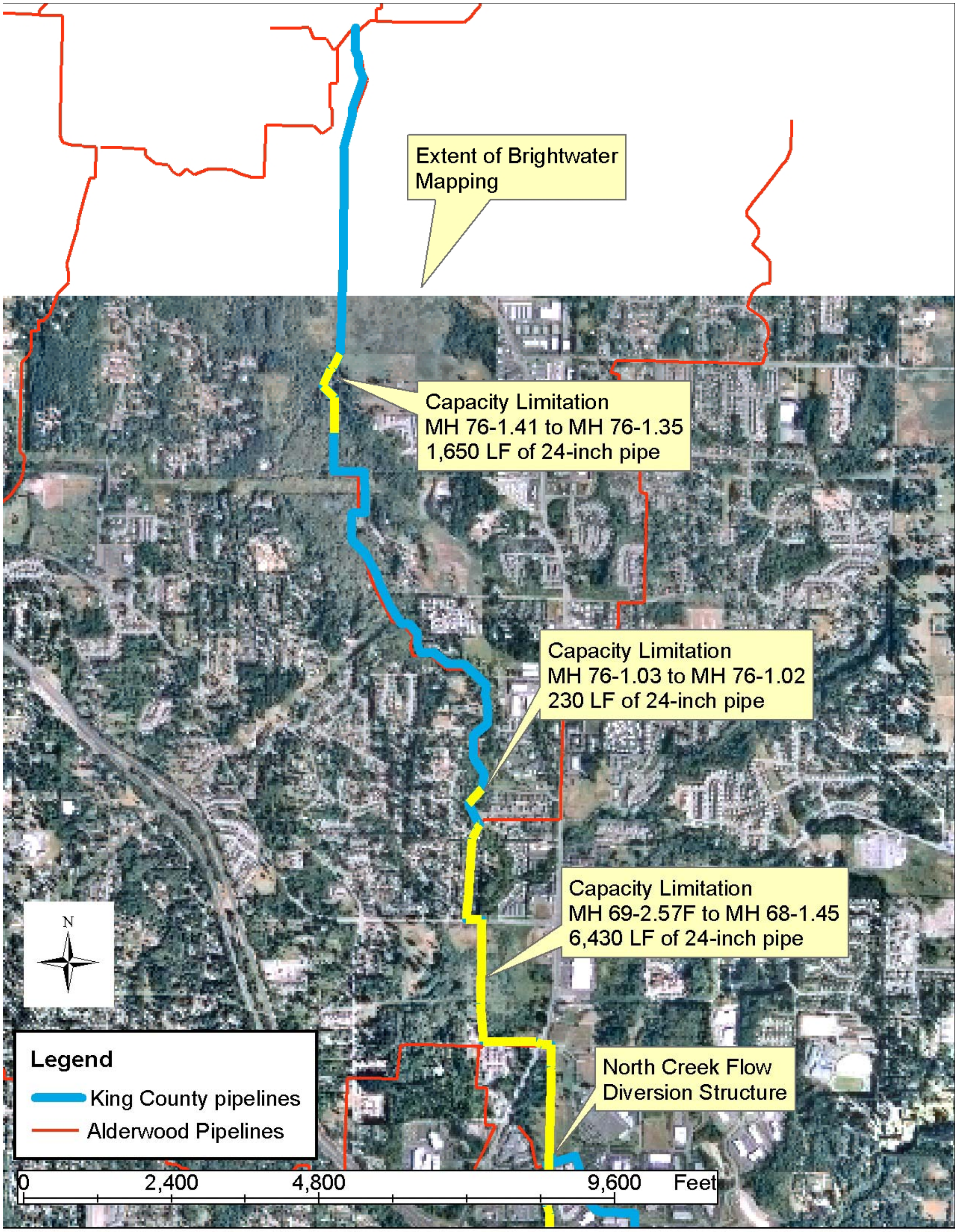

Figure 240-5. Conveyance Capacity Limitations in the North Creek Interceptor Upstream of Flow Diversion Structure

Paralleled Section of North Creek Interceptor
The North Creek Flow Diversion Structure diverts flows into two parallel pipes that connect at the King/Snohomish County Line. The western pipe is the original pipe installed by Alderwood during the installation of the North Creek Interceptor. The eastern pipe is the parallel installed by Alderwood in 1989 to 1991 to relieve high flows in the original pipe. The pipe diameters, lengths, and capacities are indicated in Table 240-20.

Table 240-20. Pipe Parameters for Paralleled Section of North Creek Interceptor

Pipe Segment	Diameter (inches)	Length (feet)	Capacity (mgd)
Western Parallel (Original Pipe)			
MH 68-1.45 to MH 68-1.32	21	5,060	4.6 – 8.8
MH 68-1.32 to MH W85-15	24	7,270	4.1 – 28.5
Eastern Parallel (Newer Pipe)			
MH 68-1.45 to MH NW29C016[1]	12	180	4.1 – 7.4
MH NW29C016[1] to MH S3-89.24	30	5,700	7.5 – 32.6
MH S3-89.24 to MH S3-89.01	36	6,830	23.2 – 74.0
MH S3-89.01 to MH W85-16	42	55	29.1
Notes:			
[1] Alderwood designation. King County designation is unavailable.			

The combination of the existing parallel pipes will not provide adequate conveyance capacity for the forecasted 20-year, 24-hour peak flows through 2010. The estimated capacity shortfall is approximately 5 to 8 mgd, depending on the pipe segment. Since this pipe has the greater capacity, it was assumed for this analysis that the flow diversion structure would be modified to maximize the use of the western parallel. The results of this analysis are shown in the flow and capacity charts for the eastern parallel in Figure 240-6. Figure 240-7 shows the same information for the western parallel while Figure 240-8 shows the location of the pipelines and the conveyance capacity limitations.

This flow routing assumption results in flows in part of the eastern parallel to exceed the pipe capacity earlier than 2010 while the need to address conveyance capacity limitations in the longer, lower capacity western parallel is delayed until after 2010. Changing the assumption to send more flows to the western parallel would result in higher net present worth costs, because the longer pipeline construction would be needed immediately while the shorter, and less expensive construction would be delayed.

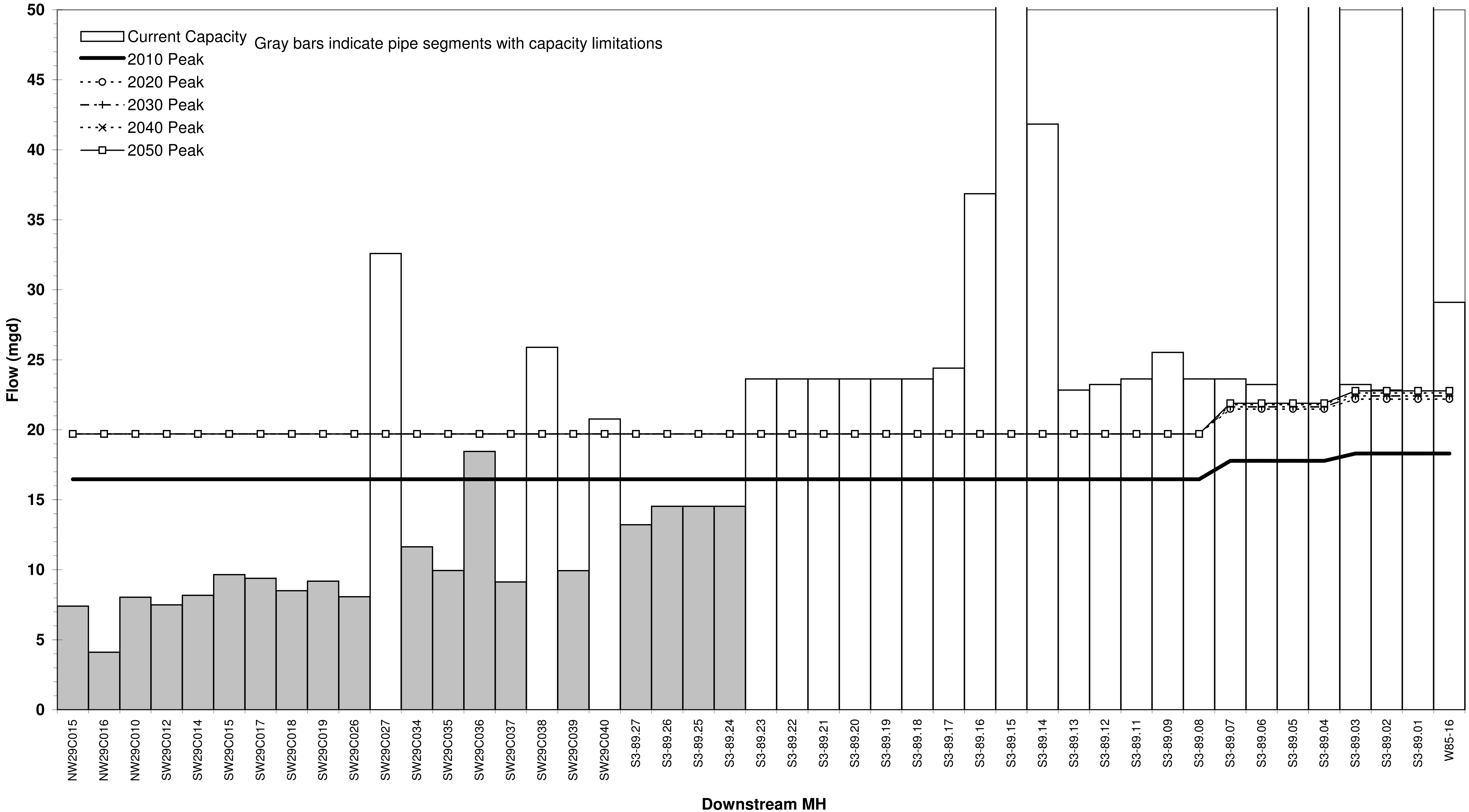

Figure 240-6. Existing Capacity and Projected Future Flows in the Eastern Parallel of the North Creek Interceptor

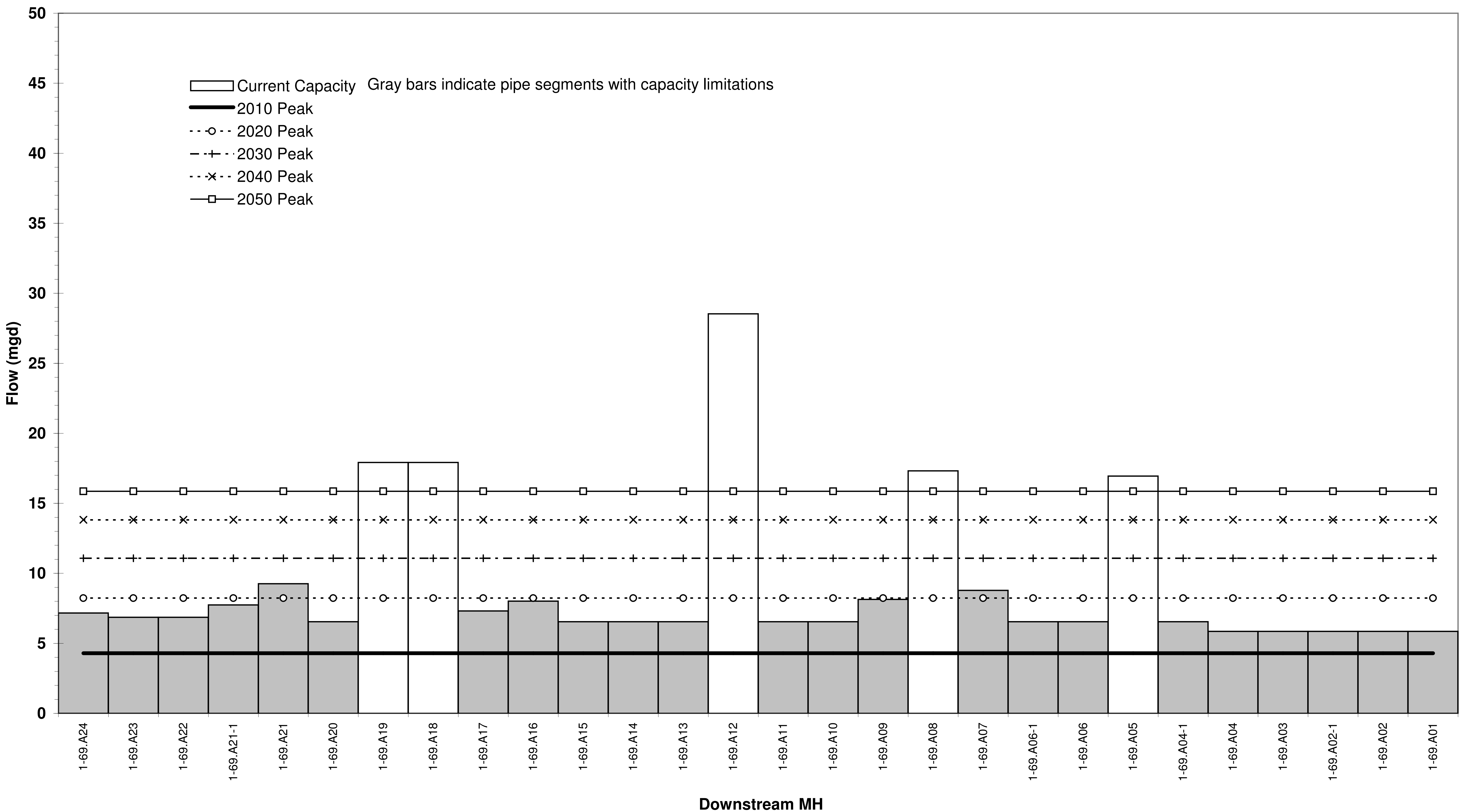

Figure 240-7. Existing Capacity and Projected Future Flows in the Western Parallel of the North Creek Interceptor

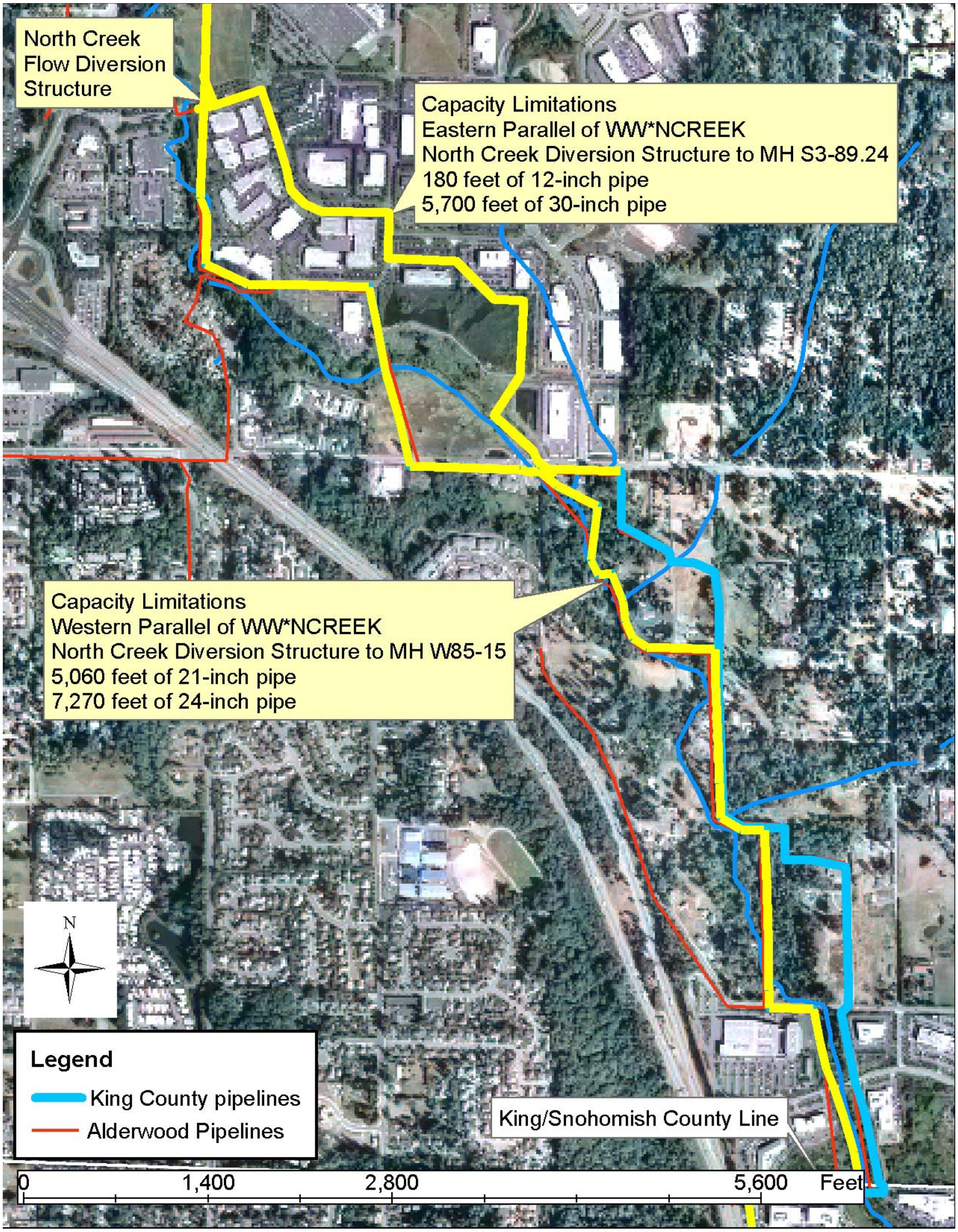

Figure 240-8. Conveyance Capacity Limitations in the Paralleled Section of North Creek Interceptor

North Creek Interceptor Downstream of Paralleled Section
The section of the North Creek Interceptor is projected to have adequate capacity to convey the flows from the parallel pipes to approximately 2015. Afterwards, conveyance capacity limitations would develop throughout this pipeline section as the wastewater flows increase. By the year 2050, the capacity shortfall would be greater than 10 mgd for most of the pipe. The projected flow and existing capacity chart of this pipeline section is shown in Figure 240-9. Figure 240-10 shows the location of the pipelines and the conveyance capacity limitations.

North Creek Interceptor Alternatives

Alternative improvements to address each of the North Creek Interceptor conveyance capacity limitations discussed in this section. For some limitations, allowing limited surcharging in some of the pipe segments would provide adequate capacity in short sections. Other limitations may be addressed through I/I reduction in the basin areas upstream of the conveyance capacity limitations. However, the majority of the limitations, including all the pipes downstream of the North Creek Flow Diversion Structure, will require either increasing the pipe size, the installation of parallel pipes, and/or adding storage.

North Creek Interceptor Upstream of Paralleled Section
The two small upstream limitations in this section (MH 76-1.41 to MH 76-1.35 and MH 76-1.03 to MH 76-1.02) can be addressed by allowing the pipe to surcharge, I/I reduction, or removing the existing pipe and installing a larger pipe. Table 240-21 lists the options that can be implemented once the pipe sections have reached capacity after 2030. Combinations of the options can be used to delay the implementation date.

Table 240-21. Options to Capacity Limitations in MH 76-1.41 to MH 76-1.35

Pipe Section	Options	Discussion
MH 76-1.41 to MH 76-1.35	Pipe surcharge	Maximum water surface elevation for the 2050 peak hour flow would be 1.3 feet above the crown of the pipe at MH 76-1.41, a level 5.1 feet below the ground surface.
	I/I reduction	A 30 percent I/I reduction in the 3,020 acre basin would reduce peak hour flows to below the capacity of the pipe through 2050.
	Pipe replacement	Replace 24-inch pipe with 30-inch pipe.
MH 76-1.03 to MH 76-1.02	Pipe surcharge	Maximum water surface elevation for the 2050 peak hour flow would be 0.2 feet above the crown of the pipe at MH 76-1.03, a level 5.5 feet below the ground surface.
	I/I reduction	Conducting a 35-percent I/I reduction in the M_ALD6 subbasin to address the capacity limitations in the pipe from MH 76-1.41 to MH 76-1.35 would also address the limitation in this pipe.
	Pipe replacement	Replace 24-inch pipe with 30-inch pipe.

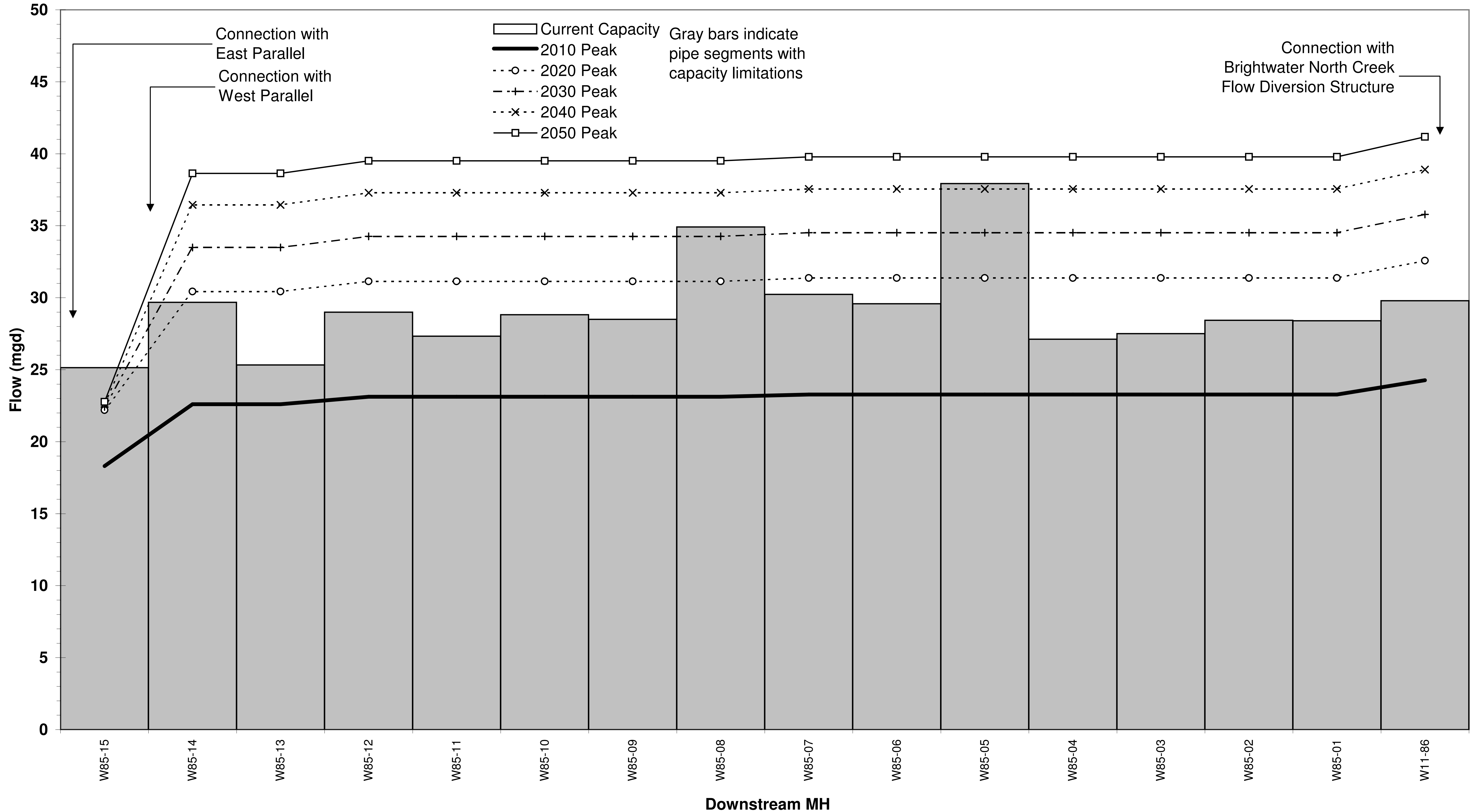

Figure 240-9. Existing Capacity and Projected Future Flows in the North Creek Interceptor in King County

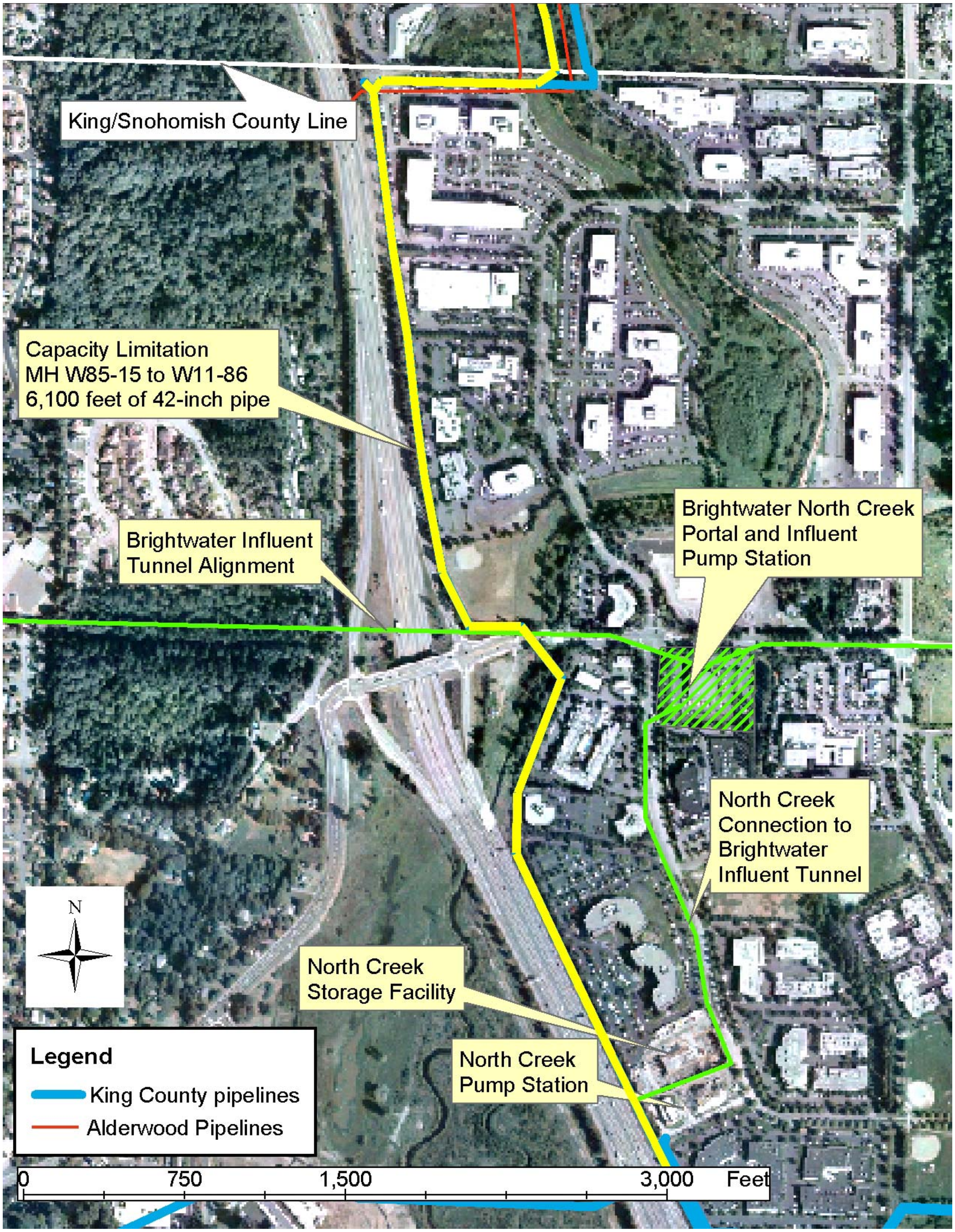

Figure 240-10. Conveyance Capacity Limitations in the North Creek Interceptor in King County

For these two pipe sections, it is recommended that the pipes be inspected in 2030 for the condition of the pipe and location of local connections. The pipe sections should be allowed to surcharge during peak flows if the pipe is in good condition and the local connections would not be negatively impacted by the high water levels. If the pipes are in good condition but surcharging could potentially impact the local system, then I/I reduction should be further investigated. Finally, if the pipes have deteriorated by the 2030 inspection date, the existing 24-inch pipes should be replaced with 30-inch pipe. Because of the relatively small increase in pipe diameter, pipe bursting should also be considered.

The third conveyance capacity limitation (MH 69-2.57F to MH 1-68.A25) is of such a magnitude (13 mgd shortfall in the 2010 and increasing to 25 mgd by 2050) that surcharging could not be used and immediate I/I reduction would not delay the need for a new pipeline . A parallel pipe or a larger replacement pipe would need to be installed to increase the conveyance capacity to meet the 2050 peak hour flow. The following alternatives have been developed to address the limitation:

- **Alternative NC1-A –** Replace existing 6,430 feet of 21-inch pipe with 3,930 feet of 36-inch pipe and 2,500 feet of 42-inch pipe prior to 2010.

- **Alternative NC1-B** – Install new flow diversion structure at MH 69-2.57F. Connect new flow diversion structure to existing flow diversion structure at MH 68-1.45 with 6,430 feet of new 30-pipe. The 2,500 feet of pipe from MH 69-2.53 to MH 68-1.45 would be replaced with 30-inch pipe shortly after 2010.

- **Alternative NC1-C** – Install a 3.3 MG offline storage facility adjacent to MH 69-2.57F and parallel the existing 21-inch pipe with a 24-inch pipe. Construction would be completed prior to 2010.

Figure 240-11 shows each of these alternatives. Since alternative would require the construction a new pipeline between MH 69-2.57F to the existing North Creek Flow Diversion Structure, it is recommended that Alternative NC1-A be selected for further refinement. Alternative NC1-B is estimated to be more costly since the cost savings for using a 30-inch pipe does not offset the cost increase for the additional construction that would need to occur shortly after 2010. Alternative NC1-C has the highest estimated cost of the three alternatives and the storage would only delay the need for downstream improvements for a few years.

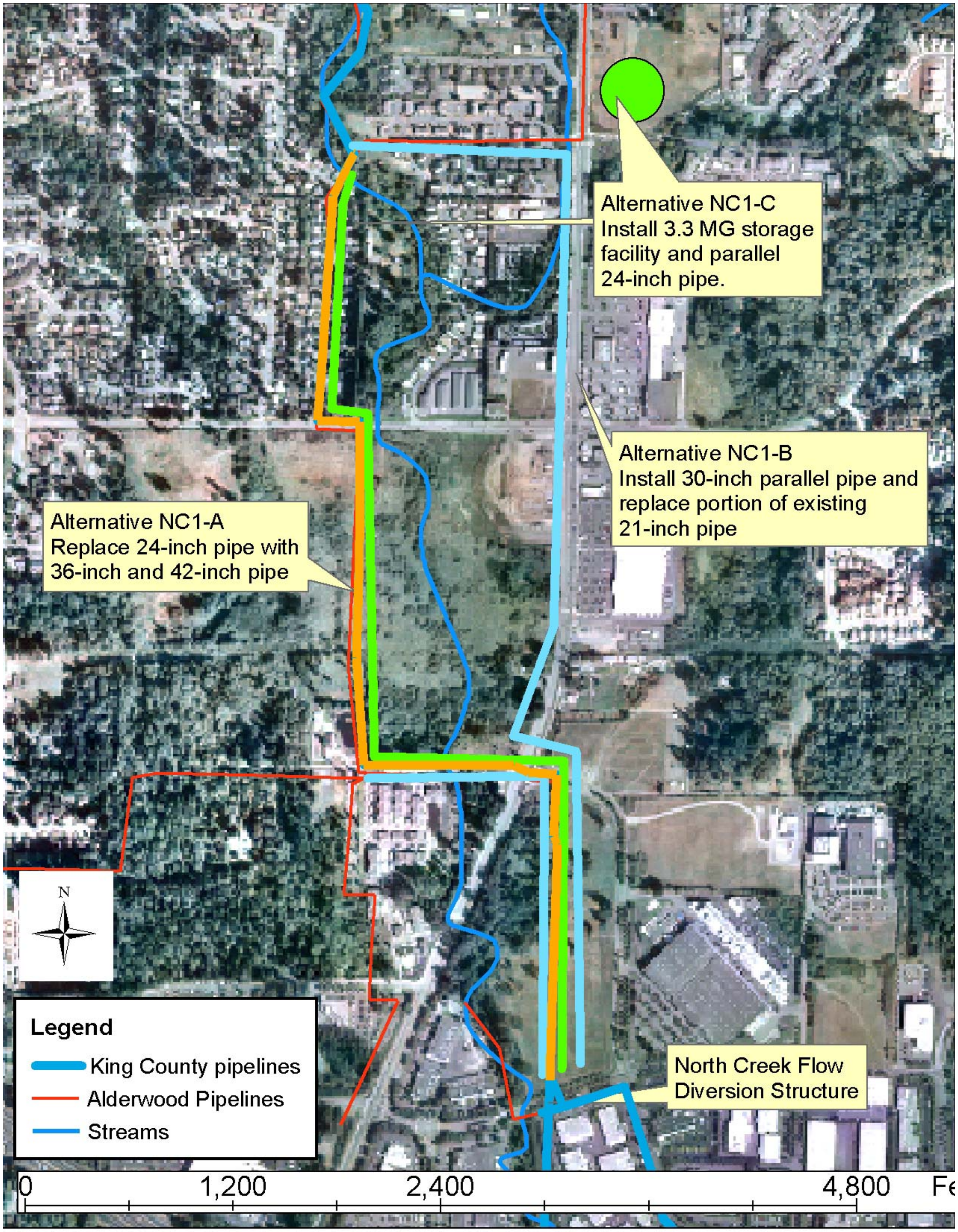

Figure 240-11. Alternatives for the North Creek Interceptor Upstream of Flow Diversion Structure

Paralleled Section of North Creek Interceptor
As mentioned previously, the capacity of the upper section of the eastern parallel would be reached before 2010. To increase the conveyance capacity through this section of the North Creek Interceptor, it is recommended that the upper reach of the eastern parallel be replaced with 5,880 feet of 36-inch pipe prior to 2010. Afterwards, there are three alternatives that can be implemented to mitigate the limitations in the entire western parallel. These alternatives are:

- **Alternative NC2-A –** Replace the western parallel from the North Creek Flow Diversion Structure to MH 1-69.A26 with 5,140 feet of 36-inch pipe by 2015. Since remaining portion of western parallel is located in easements located between residential buildings and North Creek with no direct access, 6,200 feet of new 36-inch pipe will be installed from MH 1-69.A26 to MH S3-89.07 of eastern parallel. Replace 1,450 feet of the 36-inch eastern parallel from MH S3-89.07 to MH S3-89.01 with 42-inch pipe to convey the increased flow in the lower eastern parallel. The existing western parallel south of MH 1-69.A26 would be either be abandoned or transferred to Alderwood.

- **Alternative NC2-B –** Implement a 35 percent I/I reduction by 2015 in the service area upstream of the North Creek Flow Diversion Structure. This action would delay the replacement of the western parallel from 2015 to approximately 2023 and correct the limitations discussed in the more upstream sections of this pipeline. As will be noted later, the I/I reduction would also delay the work on the downstream portions of the North Creek Interceptor by approximately 15 years.

- **Alternative NC2-C –** Construct a 6.0 MG storage facility adjacent to the North Creek Diversion Structure in 2015. This facility would eliminate the need to replace the western parallel and improve the downstream North Creek Interceptor.

- **Alternative NC2-D –** Implement I/I reduction by 2015 and construct the 2.0 MG storage facility by 2023. Western parallel replacement and improvements to the downstream North Creek Interceptor would be eliminated.

Figure 240-12 shows each of the alternatives. For this analysis, it is recommended that Alternative NC2-A be pursued. However, this recommendation is contingent on the results of the King County I/I Program. If the I/I Program concludes that I/I reduction in more cost-effective than the construction of a new pipeline, then Alternative NC2-B, with the future option of Alternative NC2-D, should be pursued.

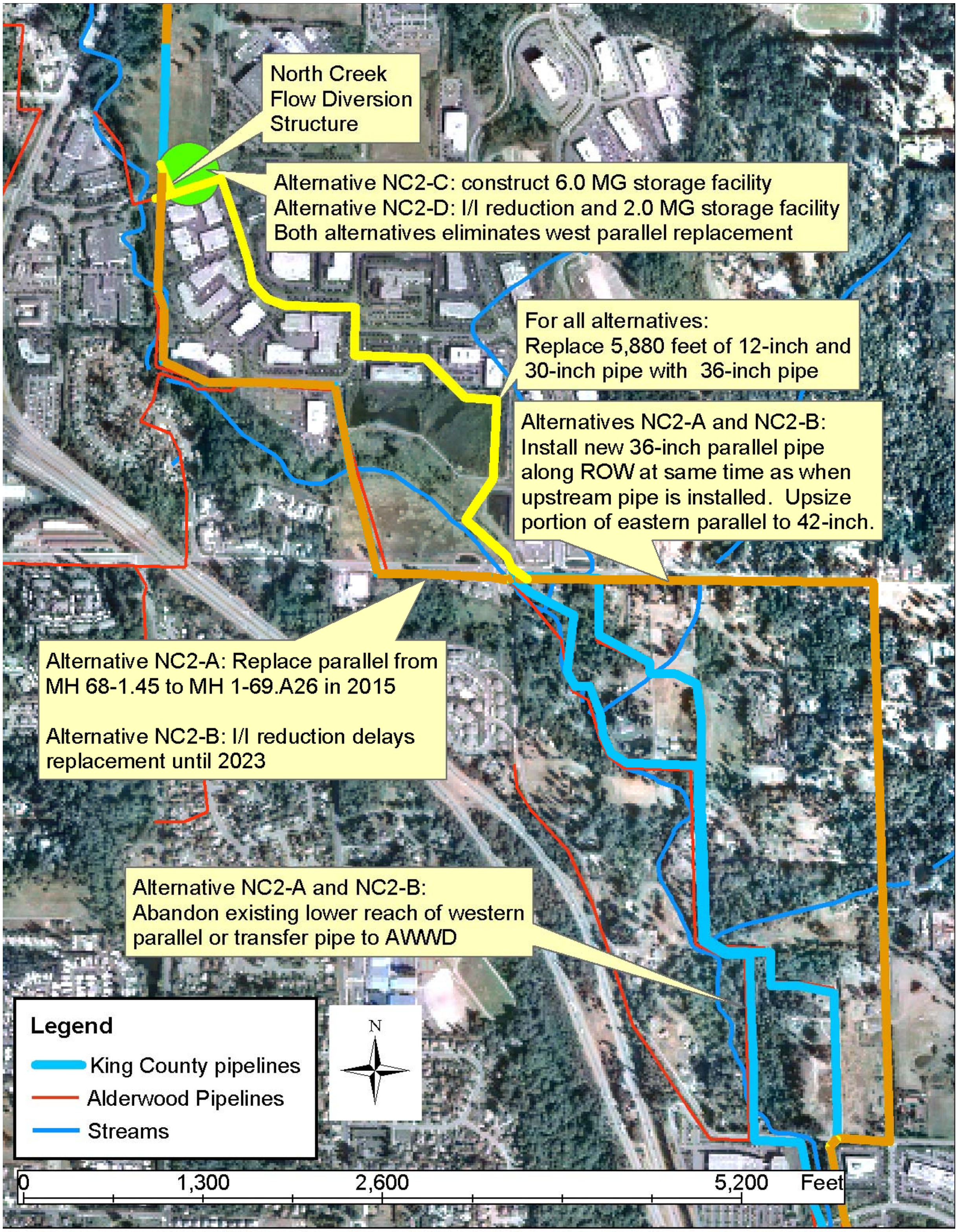

Figure 240-12. Alternatives for the Paralleled Section of North Creek Interceptor

North Creek Interceptor Downstream of Paralleled Section

The alternatives to address the capacity limitations in the section of North Creek Interceptor south of the paralleled section would need to be coordinated with the improvements planned for the Brightwater Influent Pump Station and the new North Creek Diversion Structure. In addition, any work to replace or parallel the existing pipe would be difficult as the pipe is located in a narrow easement between I-405 and office buildings.

The crown of the existing pipe is 5.5 to 18.5 feet below the ground surface. Allowing the pipe to surcharge would allow greater flow to pass through the pipe. Table 240-22 shows the varying pipe capacities as a function of water surface elevations. For this analysis, it is assumed that a surcharge of 4.0 feet above the pipe at MH W85-15 is allowed. Additional analysis should be conducted to determine if additional surcharging can be conducted without negatively impacting the local systems.

Table 240-22. Flow through North Creek Interceptor as Function of Water Surface Elevation

Water Surface Level Below Ground Surface (feet)	Pipe Capacity (mgd)
5.6 (no surcharge)	29.3
5.0	30.1
4.0	31.2
3.0	32.3
Note: Water surface elevation is at uppermost manhole, W85-15, where water surface elevations would be closest to the ground surface.	

The scheduling of any improvements to this section of the North Creek Interceptor will depend on the alternatives selected for the upstream paralleled section of the North Creek Interceptor. The alternatives that would either reduce the I/I flow or use storage to reduce the overall peak flow would delay the need to address the limitations in this section of the pipeline. Table 240-23 lists the dates that the improvements would be needed as a function of upstream improvements to the pipeline.

Table 240-23. Date that North Creek Interceptor Improvements Downstream of Parallel Section are Needed

Alternative for Paralleled Section of North Creek Interceptor	Approximate Date that Downstream North Creek Interceptor Improvements are Needed
NC2-A – Pipe replacement	2020
NC2-B – I/I reduction	2035
NC2-C – Storage	Not required
NC2-D – I/I reduction and storage	Not required

Two alternatives could be used to convey future flows expected in this pipeline:

- **Alternative NC3-A** – Construct a new flow diversion structure at the junction of the 24-inch western parallel with the 42-inch pipe. A new 30-inch pipe would be constructed connecting the flow diversion structure to the Brightwater Influent Pump Station. The new flow split will be 30 mgd to the existing North Creek Interceptor and 10 mgd would be diverted to the new pipeline.

- **Alternative NC3-B** – Replace the 42-inch pipe from the County Line to 195th Street NE. Construct a new flow diversion structure at MH W85-06 and install 770-feet of 30-inch inch pipe connecting the flow diversion structure to the Brightwater Influent Pump Station. The flow split will be the same as Alternative A.

Alternative NC3-A is recommended for implementation for this section of pipeline. Alternative NC3-B would be more expensive since the overall length of construction is longer and most of the new pipe would larger, thereby requiring a wider excavation. In addition, Alternative NC3-B would be in a confined area that would potentially impact multiple businesses, as opposed to construction in parking lots and along North Creek Parkway.

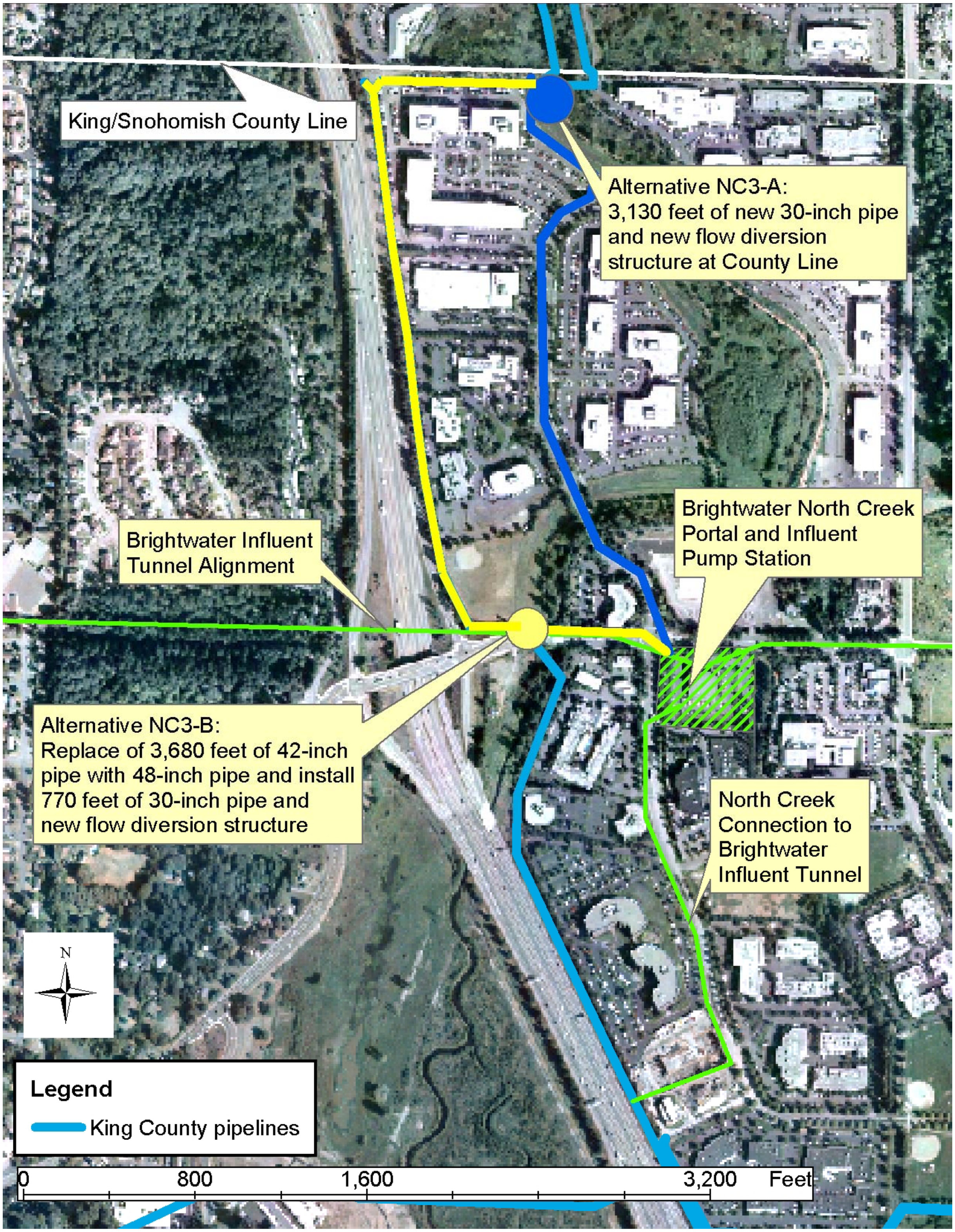

Figure 240-13. Alternatives to Mitigate Capacity Limitations in the North Creek Interceptor Downstream of Paralleled Section

NORTH CREEK PUMP STATION

With the construction of the Brightwater Treatment System, the flows that would normally be sent to the North Creek Pump Station during the wet weather season would be diverted to the Brightwater Influent Pump Station. As part of the Brightwater project, the North Creek Pump Station would continue to be available to pump wastewater to the York Pump Station either during emergencies or planned situations in which flows are being diverted away the Brightwater Treatment System for operations or inspection purposes. The facility could also be modified to serve as a water reuse booster station during the summer. The station could pump reclaimed water produced at the Brightwater Treatment Plant south to the York Pump Station for distribution in the Sammamish Valley. The Brightwater predesign reports and technical memoranda describe water reuse options and the modifications to the North Creek Pump Station. The planned modifications may change during final design of the Brightwater Treatment System.

WOODINVILLE PUMP STATION

Flows to the Woodinville Pump Station would be from Hollywood Pump Station and the local connections draining to the Sammamish Valley Interceptor (see Table 240-24). Preliminary analysis indicates that the Sammamish Valley Interceptor would only be able to convey approximately 15.0 mgd before wastewater surface elevations in the manholes the pipeline rise to within 2.0 feet of the ground surface. Increasing the surcharge to within 1.0 foot of the ground surface would allow 15.5 mgd to flow through the interceptor. The wastewater surface elevations are indicated in Figure 240-14. Operating the Hollywood PS at 16.1 mgd (the firm capacity after the pump upgrades) could result in wastewater levels rising nearly to the ground surface for a short section at the upstream end.

Table 240-24. Modeling and Flow Inputs to the Sammamish Valley Interceptor

Model Basin	Percentage of Total Basin Flow	Input Location	Notes
M_WDN002	100	MH 69-2.57F	Immediately downstream of Hollywood PS discharge structure
M_SAMVL103	50	MH W11-131	
	50	MH W11-117	
M_BOTH087	40	W11-101	Immediately upstream of Woodinville PS

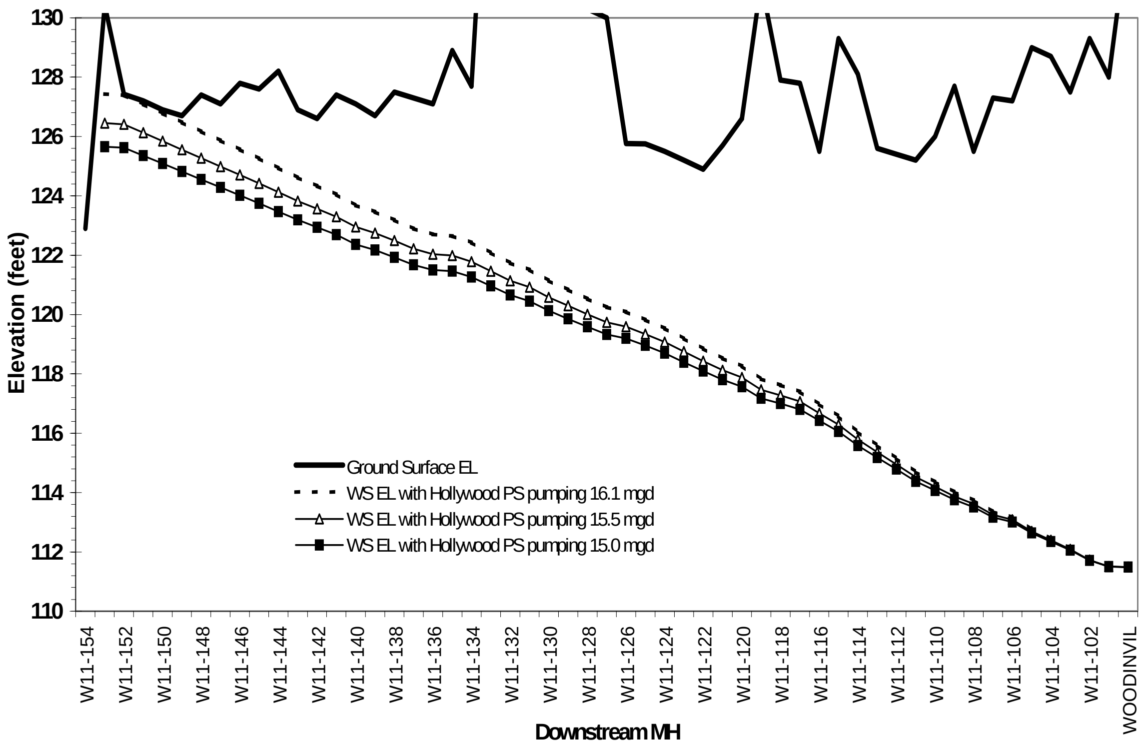

Figure 240-14. Wastewater Surface Elevations in the Sammamish Valley Interceptor

Since the Woodinville PS has a firm capacity of 17.6 mgd and a peak capacity of 22 mgd, the facility would have adequate pumping capacity. It is anticipated that overflows would occur in the Sammamish Valley Interceptor before the pumping capacity of the Woodinville PS is exceeded. No improvements are required at this facility unless subsequent improvements to the Sammamish Valley Interceptor allow higher flows to be conveyed to this station.

From approximately 2010 to 2020, the Hollywood PS could be shutdown and all flows generated from the Hollywood PS basin sent to the Eastside Interceptor (ESI) through the York PS. As such, the maximum peak hour flow through the Woodinville PS during this decade is estimated to be 5.9 mgd.

BOTHELL-WOODINVILLE INTERCEPTOR

Flows into the Bothell-Woodinville Interceptor are from the Little Bear Creek Trunk, Woodinville PS, and the model basins M_BOTH087 and M_BOT002. The location of the flow inputs and percentage of total basin flow are indicated in Table 240-25.

Table 240-25. Modeling and Flow Inputs to the Bothell-Woodinville Interceptor

Model Basin	Percentage of Total Basin Flow	Input Location	Notes
Little Bear Creek Trunk	100	MH W11-100	Flow from Little Bear Creek Trunk
Sammamish Valley Interceptor	100	MH W11-100	Flow through the Sammamish Valley Interceptor
M_BOTH087	60	MH W11-95	
M_BOT002	10	MH W11-81	
	33	MH W11-80	

As noted in the discussion for the Woodinville PS, all flows from the Hollywood PS basin could be sent to the ESI and as a result, there could be lower peak hour total flows through the Woodinville PS. The Bothell-Woodinville Interceptor could also have reduced flows until the diversion to the ESI ends in 2020.

Existing Capacity and Projected Future Flows

The Brightwater Treatment System would divert the flows in the Bothell-Woodinville Interceptor to the Brightwater Influent Pump Station through a new flow diversion structure located at MH W11-86. This flow diversion structure will have a normally closed gate that will direct all flows in the existing pipeline to the new pump station, with the downstream portion of the pipeline (MH W11-85 to MH W11-81) would receive little to no flows. The gate would regularly open at an operator-specified interval to send flows into the Bothell-Woodinville Interceptor so that any deposited solids in the pipeline can be flushed down to the Kenmore Interceptor. This gate would also open as one of the emergency flow management options to reduce flows to the Brightwater Influent Pump Station.

With the diversion, only the portion of the Bothell-Woodinville Interceptor from MH W11-100 to MH W11-86 would be reaching or exceeding capacity. The extent of the capacity limitations depends on the flow through the Hollywood PS. If the Hollywood PS is operating at 15.5 mgd, the surcharged wastewater surface elevation would come within 1.5 feet of the ground surface at MH W11-99 by 2020. Alternatively, operating the Hollywood PS at a maximum pumping rate of 11.5 mgd would reduce the estimated wastewater surface elevation to 3.1 feet below the ground surface by 2050. Figure 240-15 shows the sections of the Bothell-Woodinville Interceptor that limit flow capacity.

Figure 240-15. Limitations in the Bothell-Woodinville Interceptor

Bothell-Woodinville Interceptor Alternatives

The alternatives to address the limitations in the Bothell-Woodinville Interceptor depend upon the operation of the Hollywood PS. If the Hollywood PS is pumping 15.5 mgd, then improvements would need to be made to the limitations identified in Figure 240-15 as early 2010. However, if the Hollywood PS pumping rate is limited to 11.5 mgd, then the need to replace the existing pipe would not be required before 2050.

Alternatives	Action	Consequence
BW-A	Hollywood PS operates at a maximum of 15.5 mgd all the time	Pipe from MH W11-86 to MH W11-87 would be replaced with 60-inch pipe by 2020. Pipe from MH W11-97 to MH W11-99 would be replaced with 42-inch pipe in 2030.
BW-B	Hollywood PS operates at a maximum of 11.5 mgd all the time	Pipe replacement would not be necessary. Increased O&M costs due to increased use of the high-head York PS to pump to either ESI or Brightwater Influent Tunnel.
BW-C	Hollywood PS operates at 15.5 mgd initially, and decreasing to 11.5 mgd by 2050.	Pipe replacement would not be necessary. O&M costs would be lower than Alternative BW-B as the use of the low-head Hollywood PS is maximized.

Implementing a 35 percent I/I reduction in the 27 square mile King County service area upstream of the Bothell-Woodinville Interceptor from 2010 to 2020 could eliminate the need for pipe replacements in Alternative BW-A. Reducing I/I could also reduce the use of the York PS for Alternatives BW-B and BW-C. Since I/I implementation is outside the scope of this report, it is recommended that Alternative BW-A be further studied but that the option of using I/I reduction to either eliminate or defer the improvements be reexamined after the completion of the I/I program reports.

SWAMP CREEK TRUNK AND SWAMP CREEK BYPASS

The inputs into the Swamp Creek Trunk are listed in Table 240-26. An option of the Brightwater Treatment System is to construct a new flow diversion structure at MH 99-19 to divert all flows from the downstream sections of the Swamp Creek Trunk into the Brightwater Influent Tunnel at the North Kenmore Portal. The diversion would occur for the majority of the time. However, for the decade from 2030 to 2039, the new diversion structure could split the flows. During this time, the first 18.3 mgd could be sent to the Brightwater Influent Tunnel. Remaining flows above 18.3 mgd would continue to be conveyed in the Swamp Creek Trunk to the Kenmore Interceptor.

Table 240-26. Modeling and Flow Inputs to the Swamp Creek Trunk

Model Basin	Percentage of Total Basin Flow	Input Location
M_ALD014	100	MH S1-90.C65
M_ALD039	100	MH S1-90.A29
M_ALD12	100	MH S1-90.A28
M_ALD006	100	MH S1-90.A2
M_NUD5	17	MH S1-90.A1
	26	MH S1-79.35
	23	MH S1-79.13
	34	MH 99-27
M_SWAMP004	29	MH 99-16
	30	MH W501-10
	41	MH W501-04

Existing Capacity and Projected Future Flows

For this analysis, the Swamp Creek Trunk was divided into three sections: the northern most section upstream of I-405, the section of pipe from I-405 to the King/Snohomish County Line, and the section in King County that conveys flow to either the planned Brightwater Swamp Creek Diversion Structure or to the Swamp Creek Bypass Pipe.

Swamp Creek Trunk Upstream of I-405

The existing capacity and projected future flows of the Swamp Creek Trunk upstream of I-405 are shown in Figure 240-16. As the figure shows, the upper reach of the pipeline would have adequate capacity to convey peak flows through 2050.

Swamp Creek Trunk from I-405 to the County Line

Figure 240-17 shows the capacity and estimated future flows for the pipe segments in the Swamp Creek Trunk from I-405 to the King/Snohomish County Line. There are four pipe sections that do not have adequate capacity to convey the estimated future flows. These sections are shown in Figure 240-18 and listed in Table 240-27.

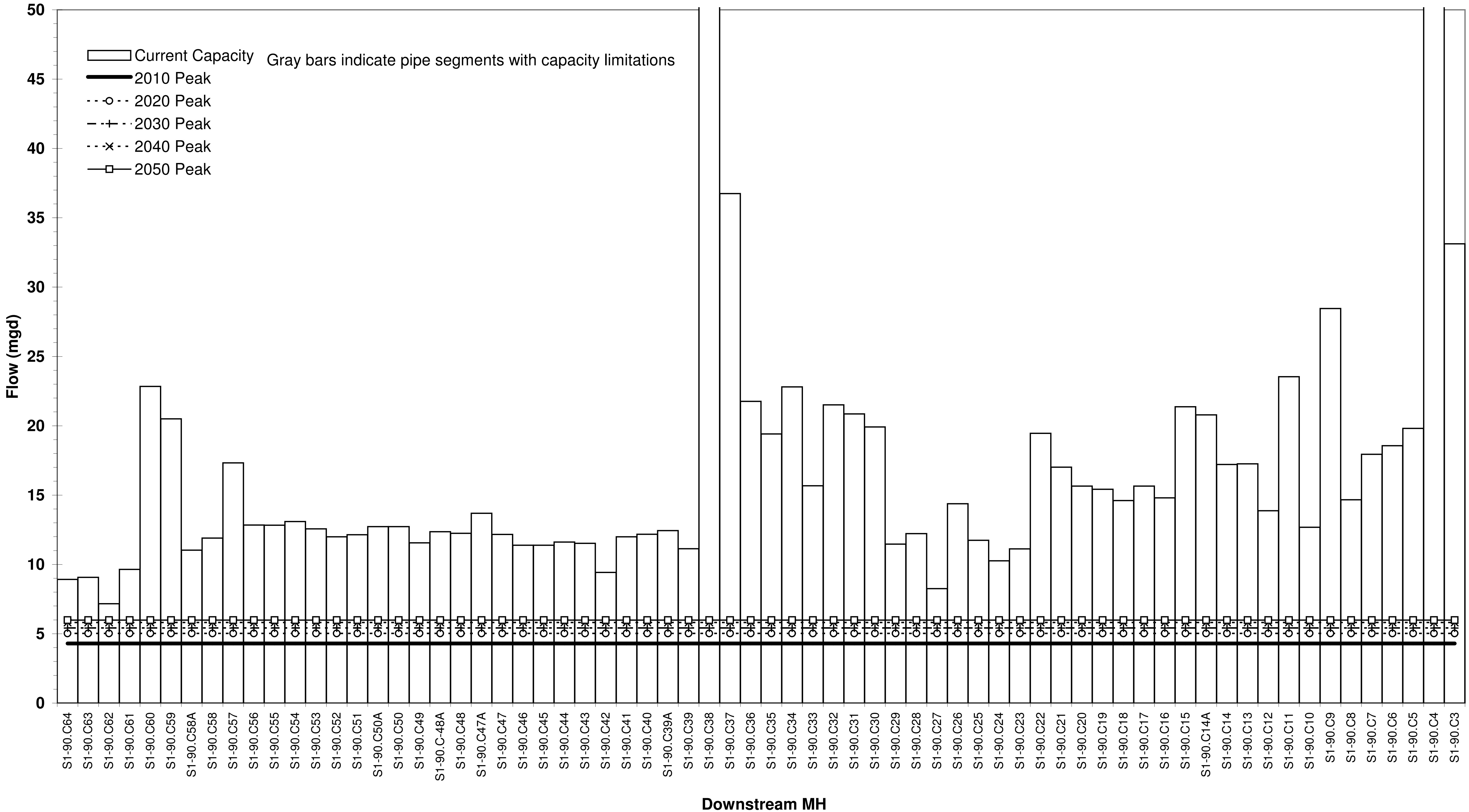

Figure 240-16. Existing Capacity and Projected Future Flows in the Swamp Creek Trunk Upstream of I-405

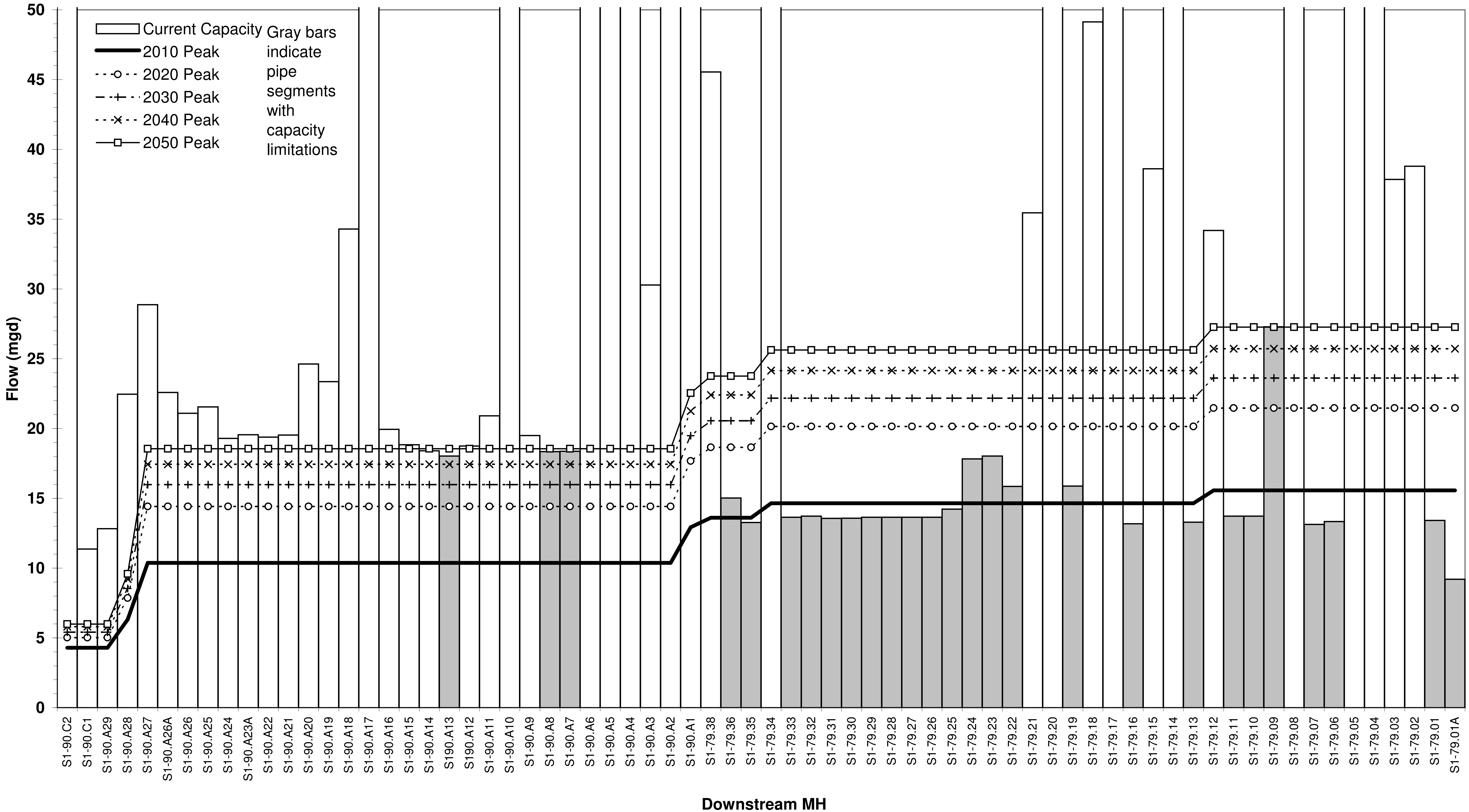

Figure 240-17. Existing Capacity and Projected Future Flows in the Swamp Creek Trunk from I-405 to the County Line

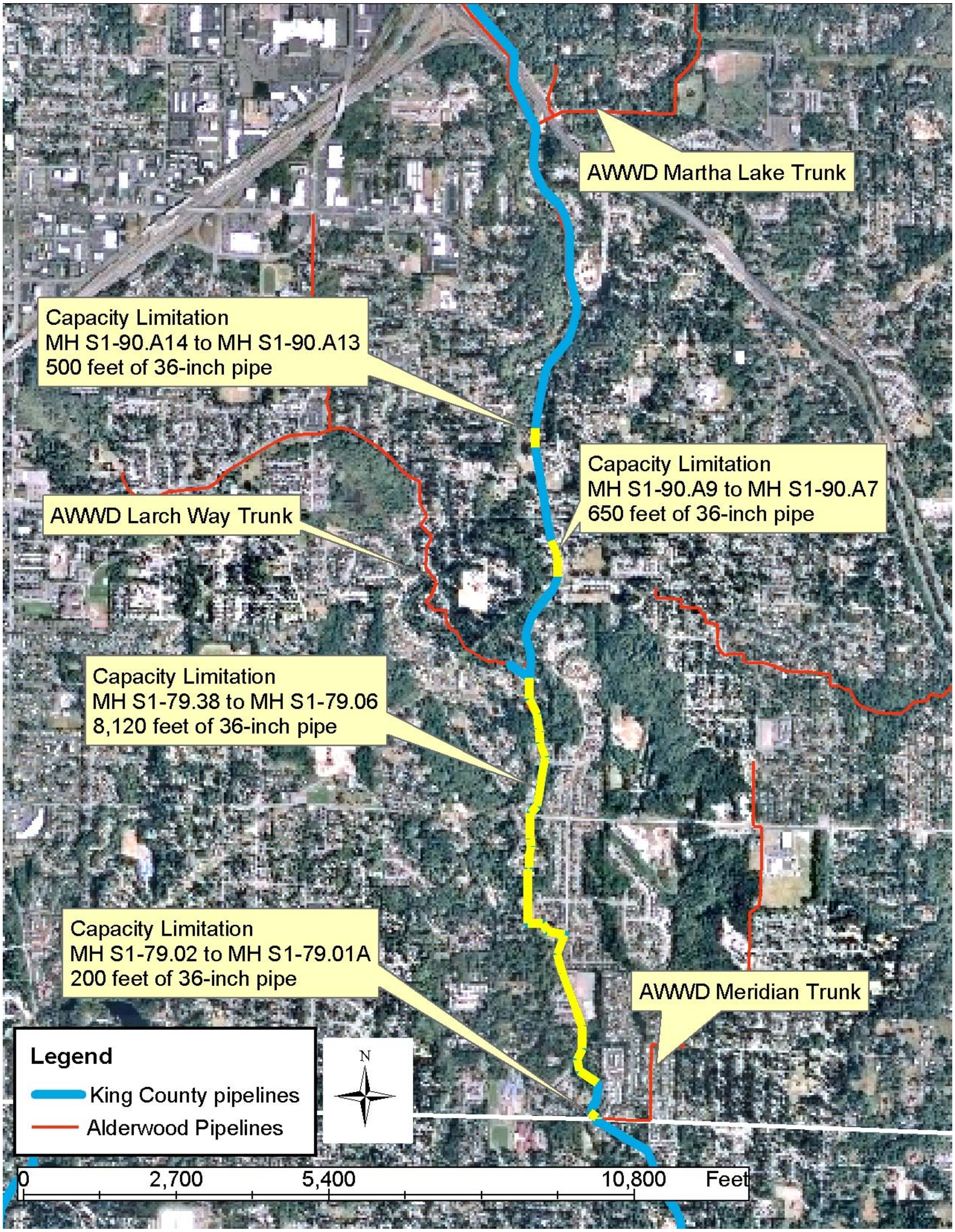

Figure 240-18. Limitations in the Swamp Creek Trunk from I-405 to the County Line

Table 240-27. Conveyance Capacity Limitations in the Swamp Creek Trunk from I-405 to the King/Snohomish County Line

Upstream MH	Downstream MH	Pipe Length (feet)	Pipe Diameter (inches)	Year Capacity is Exceeded
S1-90.A14	S1-90.A13	330	36	2045
S1-90.A9	S1-90.A7	650	36	2045
S1-79.38	S1-79.06	8,120	36	2010
S1-79.02	S1-79.01A	200	36	2010

Swamp Creek Trunk Downstream of the County Line

The analysis assumed that the construction of the new diversion structure will be the baseline condition and that alternatives will be developed to determine if pipe replacement or constructing a parallel is feasible. Figure 240-19 shows the capacity and estimated future flows for the pipe segments in the Swamp Creek Trunk from the King/ Snohomish County Line to the Kenmore Interceptor with the diversion structure. The diversion structure would reduce flows in the pipeline to below the capacity of the pipeline. Note, the higher flows in 2030 are due to the anticipated flow split as part of the Brightwater flow management plans. This analysis also assumes that flows in excess of the Swamp Creek Bypass conveyance capacity would be conveyed by the section of the Swamp Creek Trunk between the Swamp Creek Bypass and the Kenmore Interceptor.

A large section of the Swamp Creek Trunk would have inadequate conveyance capacity if the diversion structure is not constructed. Figure 240-20 shows the flows in the pipeline without the diversion at MH 99-18. A total of 3,620 feet of the existing 36-inch pipe would not have the capacity to convey peak flows by approximately 2015. Figure 240-21 shows the location of the limitation.

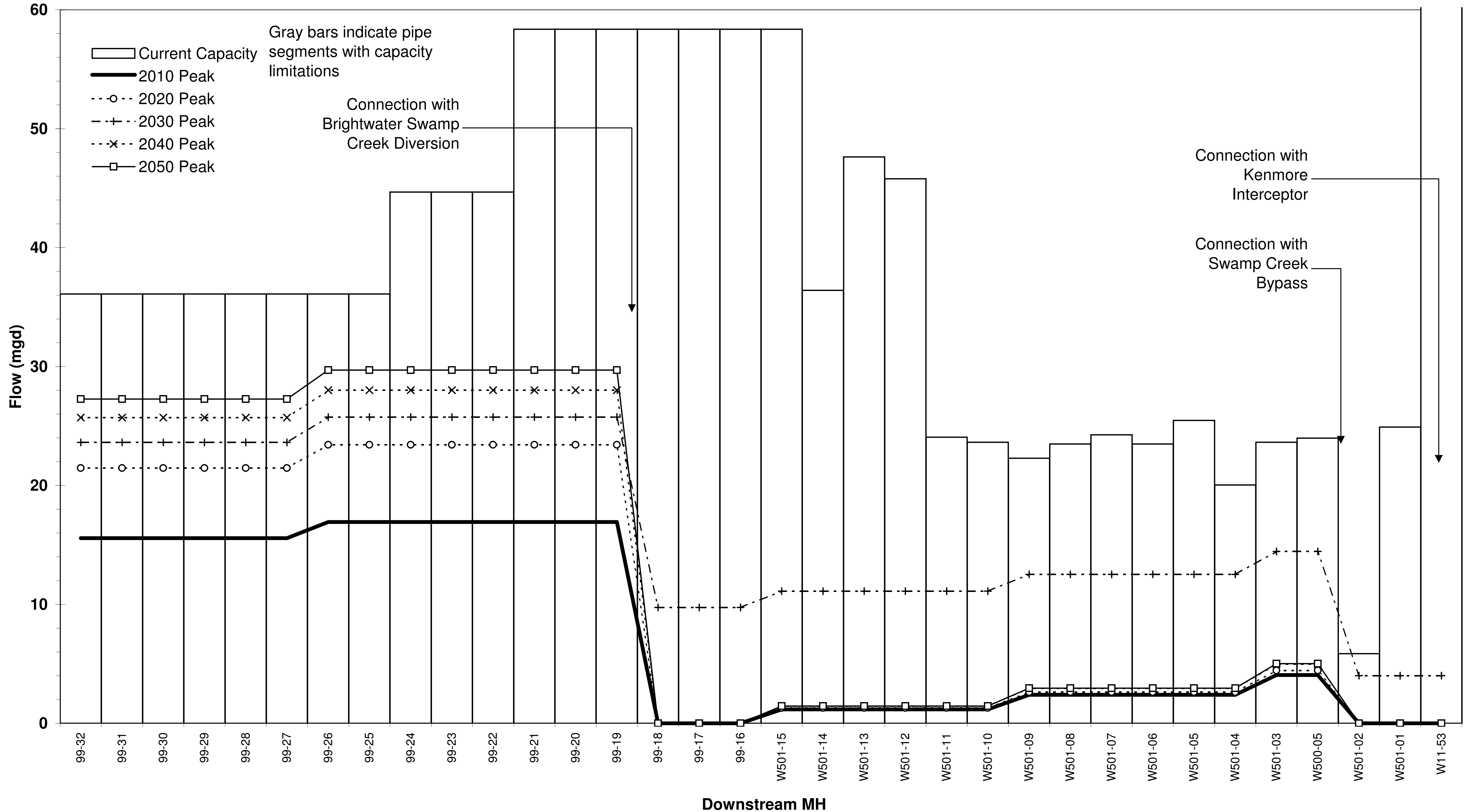

Figure 240-19. Projected Future Flows in the Swamp Creek Trunk Downstream of the County Line with the Brightwater Swamp Creek Diversion

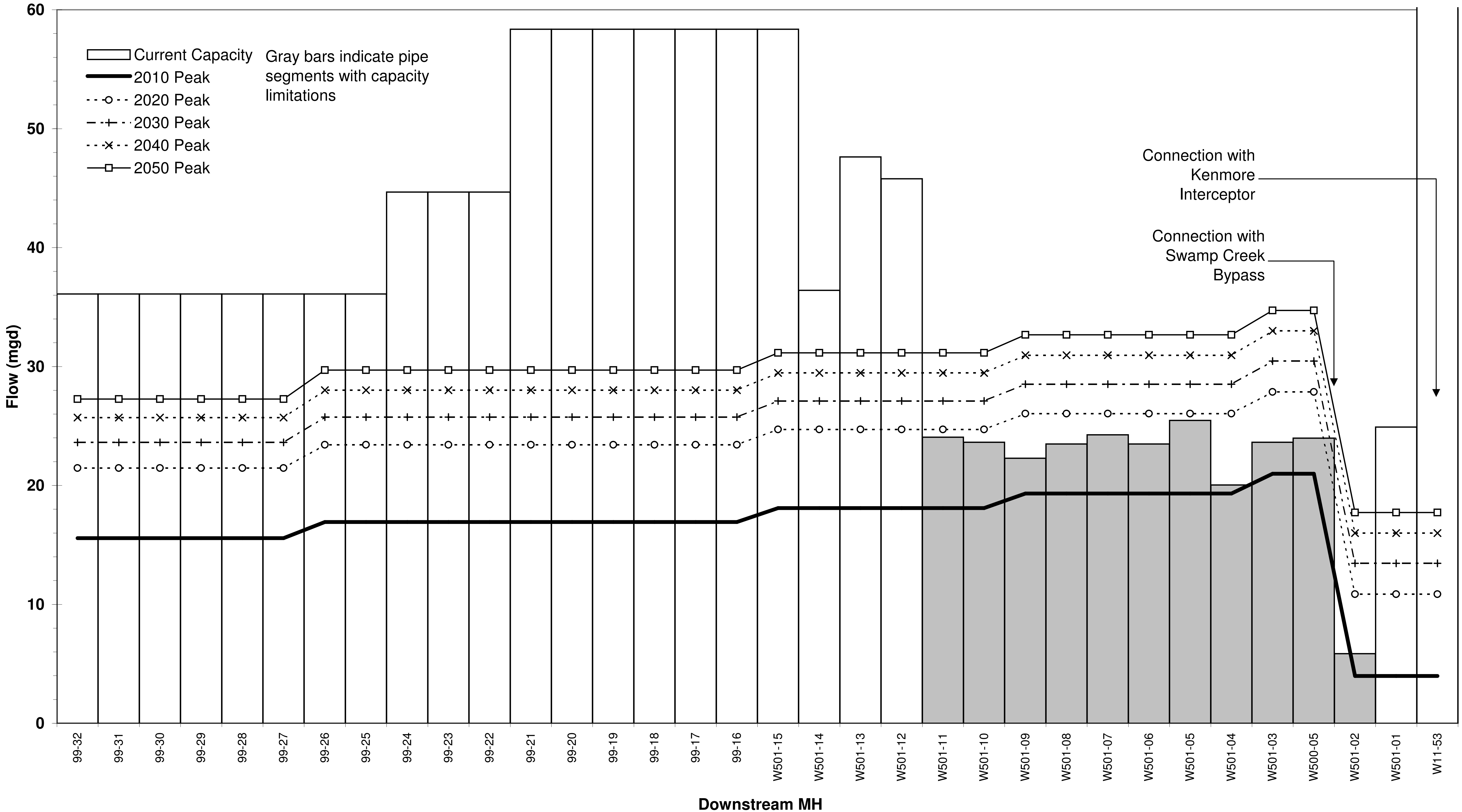

Figure 240-20. Projected Future Flows in the Swamp Creek Trunk Downstream of the County Line without the Brightwater Swamp Creek Diversion

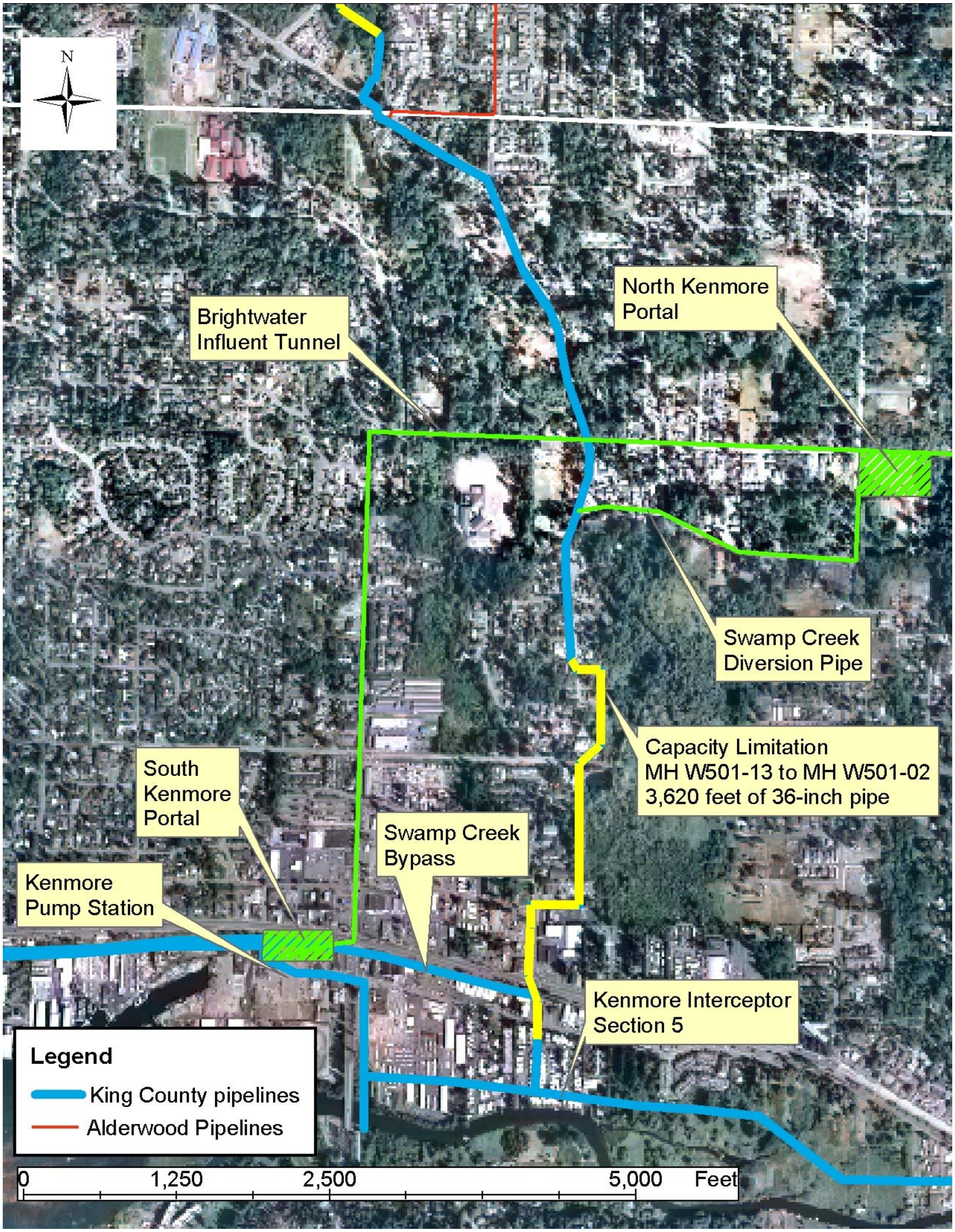

Figure 240-21. Limitations in the Swamp Creek Trunk if the Brightwater Swamp Creek Flow Diversion Structure is not Constructed

Swamp Creek Trunk Alternatives

The alternative improvements to address the Swamp Creek Trunk conveyance capacity limitations in the section from I-405 to the County Line and from the County Line to the Kenmore Interceptor are presented in this section. For some limitations, allowing wastewater to surcharge in the pipe would provide adequate capacity in the limited pipe sections. Other limitations may be addressed through I/I reduction in the basin areas upstream of the conveyance capacity limitation. However, many of the limitations will require either replacing the pipe, the installation of parallel pipes, and/or adding storage.

Swamp Creek Trunk from I-405 to the County Line

The first two upstream limitations in this section (MH S1-90.A14 to MH S1-90.A13 and MH S1-90.A9 to MH S1-90.A7) can be addressed by allowing the pipe to surcharge, I/I reduction, or removing the existing pipe and installing a larger pipe installed. Table 240-28 lists the options that can be implemented once the pipe sections have reached capacity after approximately 2045.

Table 240-28. Options to Capacity Limitations in MH S1-90.A14 to MH S1-90.A7

Pipe Section	Options	Discussion
MH S1-90.A14 to MH S1-90.A13	Pipe surcharge	Maximum water surface elevation for the 2050 peak hour flow would be less than 0.1 feet above the crown of the pipe at MH S1-90.A14.
	I/I reduction	A 2 percent I/I reduction in the 6,020 acre basin would reduce peak hour flows to below the capacity of the pipe through 2050.
	Pipe replacement	Replace 42-inch pipe with 36-inch pipe.
MH S1-90.A9 to MH S1-90.A7	Pipe surcharge	Maximum water surface elevation for the 2050 peak hour flow would be less than 0.1 feet above the crown of the pipe at MH S1-90.A9.
	I/I reduction	Conducting the I/I reduction to address the capacity limitations in the pipe from MH S1-90.A14 to MH S1-90.A13 would also address the limitation in this pipe.
	Pipe replacement	Replace 36-inch pipe with 42-inch pipe.

For these two pipe sections, the pipes should be inspected in 2040 for the condition of the pipe and location of local connections. The pipe sections should be allowed to surcharge if the pipe is in good condition and the local connections would not be negatively impacted by the high wastewater levels. If the pipes are in good condition but surcharging could potentially impact the local system, then some I/I reduction may be required. Finally, if the pipes have deteriorated by 2040, then the existing 36-inch pipes should be replaced with 42-inch pipe.

The pipe from MH S1-79.38 to MH S1-79.06 and from MH S1-79.02 to MH S1-79.01A would reach capacity shortly after 2010. Two alternatives have been developed to address the limitations in the pipe:

- **Alternative SC1-A –** Replace the existing pipe with 8,320 feet of 48-inch pipe.

- **Alternative SC1-B –** Install 8,320 feet of parallel 36-inch pipe. The pipe following the same right-of-way as the existing pipe. Replace the existing 200 feet of 36-inch pipe between MH 79.02 to MH 79.01A.

Implementing a 35 percent I/I reduction would only delay the time that the existing pipe reaches capacity to approximately 2015. Since the impacts would be nearly identical for the two alternatives, Alternative SC2-B should be implemented as the construction costs would be slightly less as the pipe is smaller and construction of the pipe would not potentially disrupt existing service.

Swamp Creek Trunk Downstream of the County Line

The construction of the Brightwater Swamp Creek Diversion Structure at MH 99-19 would remove enough flows from the Swamp Creek Trunk to prevent conveyance capacity limitations from developing in the pipe. The option in the Brightwater conveyance design project to eliminate the diversion structure would result in conveyance capacity limitations developing in a long section of the pipeline. Four alternatives have been developed to address this limitation (see Table 240-29).

Table 240-29. Alternatives to Address Swamp Creek Trunk Limitations in King County

Alternative	Discussion
SC2-A	Install a parallel pipe using microtunneling.
SC2-B	Modify existing pipe to allow pipe pressures to reach 16 feet of water.
SC2-C	Combination of pipe pressure modifications and pipe replacement
SC2-D	Replace existing pipe with 3,620 feet of 42-inch pipe

Alternative SC2-A – Parallel Pipe

Alternative SC2-A provides a parallel 42-inch pipe from MH W501-1 to MH W501-12 along 73rd Avenue NE. A section of the pipe is over 25 feet in depth and is represented in the alternative as constructed by microtunneling. Shallower portions of the pipe may be constructed by either open-cut trenching or microtunneling. Because of the high volume of traffic on 73rd Avenue NE, microtunneling was assumed.

Although a parallel pipe needs to only convey the flow above the existing pipe capacity, it is generally accepted that a minimum pipe size for microtunneling is 36 inches. However, since a 36-inch pipe is not large enough to convey the entire design flow, it would make sense to install a 42-inch pipe which would have the capacity to convey the total design flow. Therefore, this alternative is represented by a 42-inch microtunnel to convey all projected future flows. The existing trunk would remain in service to serve local connections and to provide an alternate route for flows if maintenance is required on the new trunk. A structure would be built at MH W501-12 that would allow King County to divert flows into the existing trunk if needed.

Key components of this alternative are as follows:

- 3,000 feet of 42-inch microtunnel
- Six manholes at jacking pits
- Six jacking/receiving pits (30 feet deep, in areas of high ground water)
- Cross under two Tolt water transmission lines
- Diversion structure at MH W501-15 (12 feet x 12 feet x 16 feet deep, with two gates)
- Connection manhole at MH W501-01

Alternative SC2-B – Modify Existing Pipe for Low Pressure

This alternative allows the pipe to surcharge to convey the flows. Because the pipe was not designed for low pressure flows, the pipe would require lining between MH W510-01 and MH W501-15. A concern in surcharging the existing pipe is the impact on the hydraulics of connections to the trunk. King County indicates that there are four local connections into this trunk. The hydraulic analysis indicated that the existing pipe maybe surcharged to an elevation of 16 feet above the crown of the pipe, which would likely impact local connections. This alternative is not recommended.

Alternative SC2-C – Combination Pipe Replacement and Surcharging

This alternative replaces the southern portion of the trunk with a 42-inch pipe and allows the northern portion of pipe to surcharge. Because the pipe was not designed for low pressure flows, the pipe will require lining between MH W510-06 and MH W501-15. A concern in surcharging the existing pipe is the impact on the hydraulics of connections to the trunk. King County indicates that there are four local connections into this trunk. The hydraulic analysis indicated that the existing pipe maybe surcharged to an elevation of 8.5 feet above the crown of the pipe. Since, this surcharge will likely have an impact on local connections, this alternative is not recommended.

Alternative SC2-D – Replace Pipe

This alternative is not recommended due to restricted construction access issues. The existing pipe is located in an easement that lies inside of or slightly west of the large wetland on Swamp Creek. In addition, access to the pipe would mostly be through homes or a fire station. There is no direct road or alley access to the majority of the pipe.

KENMORE INTERCEPTOR SECTION 5

The Kenmore Interceptor Section 5 receives flows from the Bothell-Woodinville Interceptor, Swamp Creek Trunk, Inglewood Interceptor, and flows from four model basins. The location of the flow inputs and percentage of total basin flow are listed in Table 240-30.

Table 240-30. Modeling and Flow Inputs to the Kenmore Interceptor Section 5

Model Basin or Pipeline	Percentage of Total Basin Flow	Input Location	Notes
Bothell-Woodinville Interceptor	100	MH W11-78	Flow from Bothell-Woodinville Interceptor
M_BOT002	40	MH W11-74	
	17	MH W11-69	
Swamp Creek Trunk	100	MH W11-53	Flow from Swamp Creek Trunk
M_KENMR054	33	MH W11-62	
	16	MH W11-59	
	51	MH W11-56	
M_INGWD51A	100	MH W11-51	Flow from Inglewood Interceptor
M_KENMR041	100	Secondary Distribution Structure	

With the diversion of much of the flows from the Bothell-Woodinville Interceptor to the Brightwater Influent Tunnel, the Kenmore Interceptor Section 5 will generally have adequate capacity to convey remaining future flows. Figure 240-22 shows the projected flows and capacity in this section of the pipeline. The one section that has insufficient capacity is the 320 feet long section of 78-inch diameter pipe between MH W11-50 and MH W11-49. Review of the as-built drawings for this section indicates that a correction to the pipe slope and alignment indicates that this section of pipe sank shortly after installation. To correct the problem, the invert for this section of pipe was paved with as much as 2 feet of grout to restore the invert slope. The Brightwater Safety Relief Facility (SRF) is being constructed in this area and would require that the Kenmore Interceptor Section 5 be capable of conveying at least 80 mgd to the SRF. As a result, this restricted 78-inch pipe section should be replaced by 2010. The limitation becomes greater if the Brightwater Swamp Creek Diversion is not constructed and the flows from Swamp Creek Trunk continue entering the Kenmore Interceptor (see Figure 240-23). Figure 240-24 shows the location of this limitation.

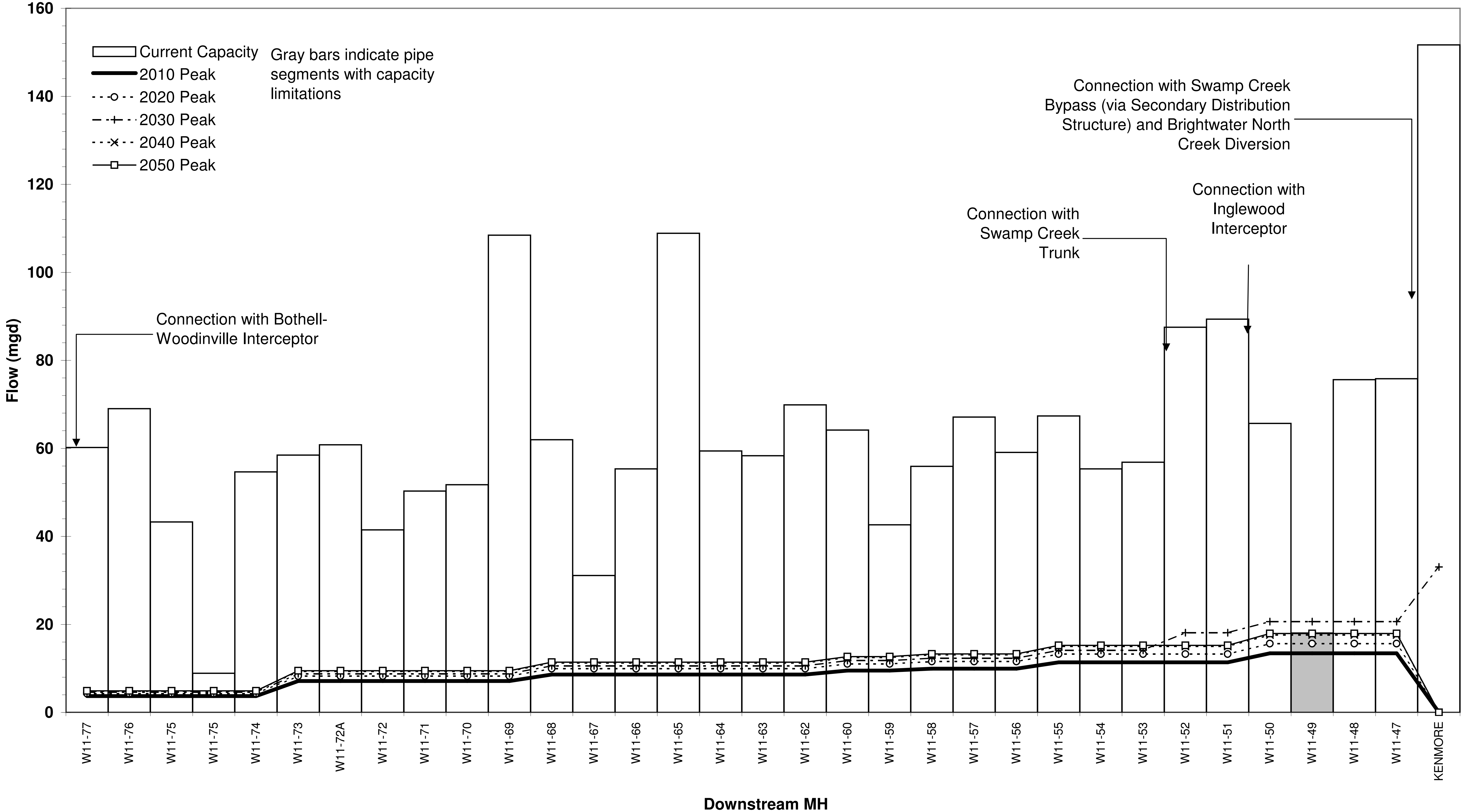

Figure 240-22. Projected Future Flows in the Kenmore Interceptor Section 5 with the Brightwater Swamp Creek Diversion

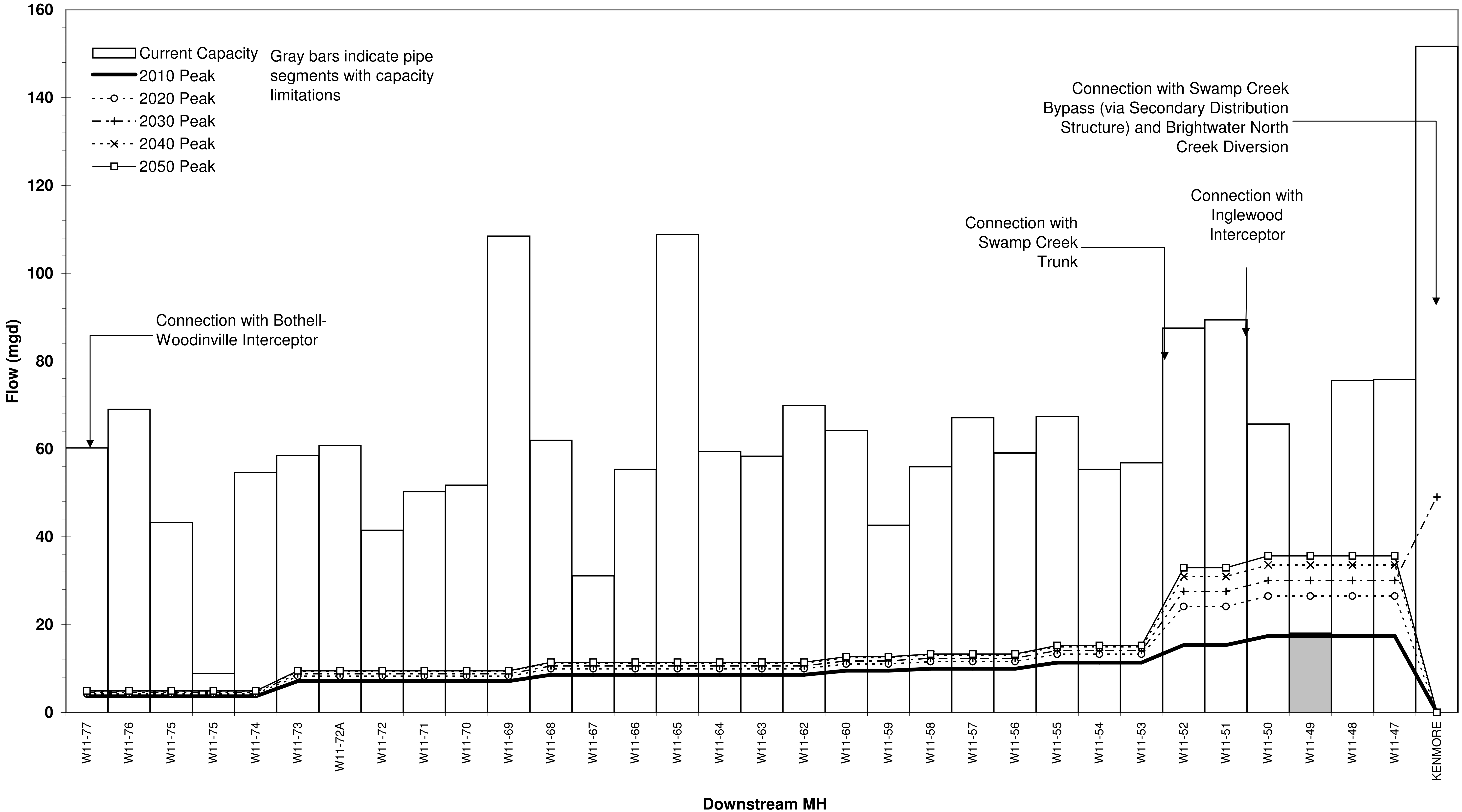

Figure 240-23. Projected Future Flows in the Kenmore Interceptor Section 5 without the Brightwater Swamp Creek Diversion

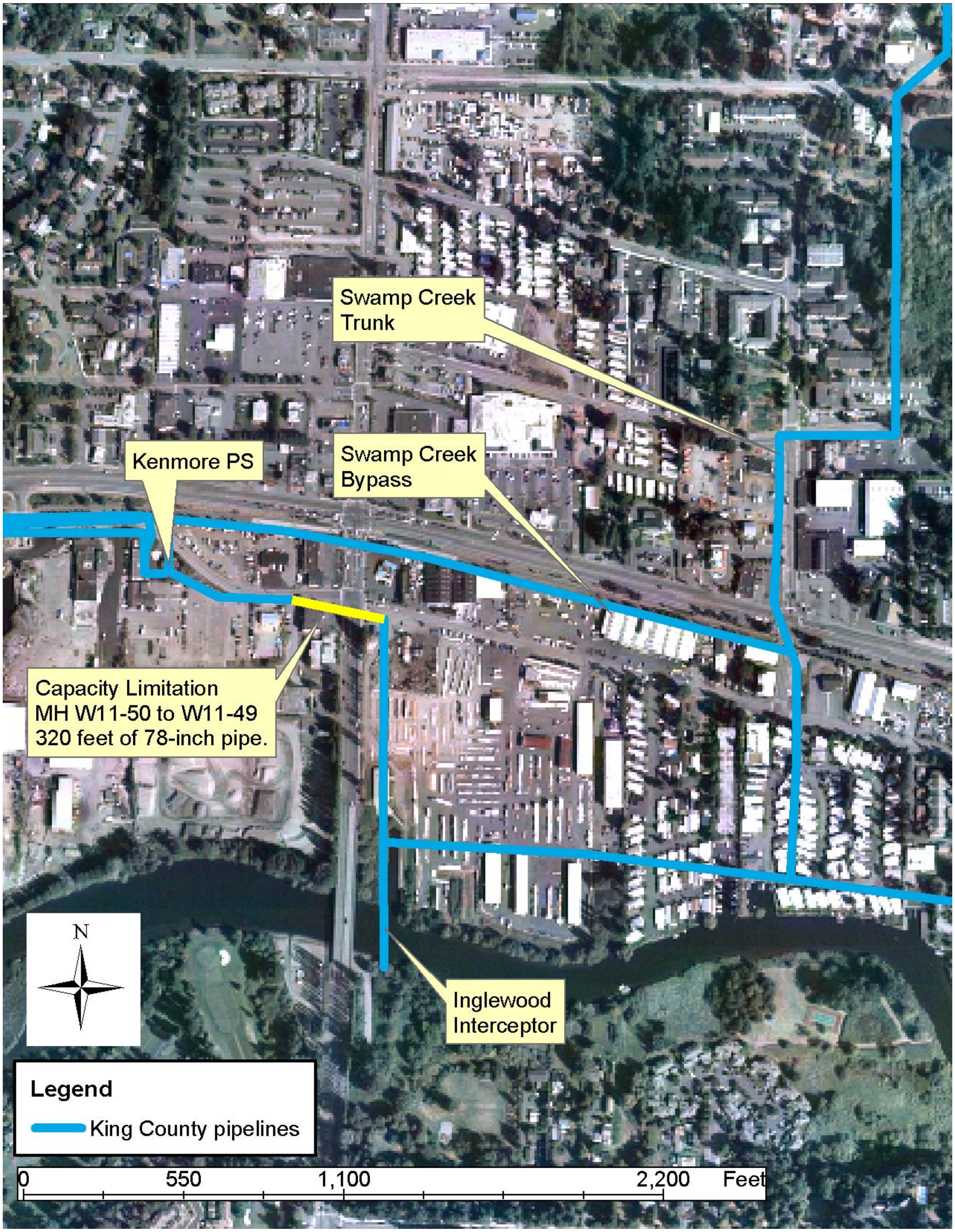

Figure 240-24. Conveyance Capacity Limitations in the Kenmore Interceptor

KENMORE PUMP STATION

Under normal conditions, flows that currently pass through the Kenmore Pump Station would be diverted to the proposed Brightwater Influent Tunnel for the majority of the time from 2010 to 2050. From approximately 2030 to 2039, the Kenmore Pump Station could be routinely used to pump flow to use available capacity at the West Point TP while delaying the Brightwater TP expansion. Since flows downstream of the Kenmore Pump Station need to be limited to the 26 mgd Kenmore Interceptor Section 2 (“Kenmore Lakeline”) capacity, the existing pump station will have adequate capacity to meet future requirements to pump either to the Kenmore Lakeline or to the Logboom Storage Pipes. As will be noted in subsequent discussions regarding the Lake Ballinger McAleer and McAleer Trunks, there may not be available capacity in the Kenmore Lakeline for the Kenmore PS during peak flow events so flows would have to be diverted to the Logboom Storage Pipes or the Brightwater Influent Tunnel for storage.

After the Brightwater Treatment System is in operation, typically, the pump station would only be operated to divert flow away from the Brightwater Treatment System during emergencies or for scheduled work. Provisions are being made to allow the station to be operated automatically to exercise the equipment during shutdown periods as well remotely start the station when needed for emergency flow diversions. This work is being conducted as part of the Brightwater conveyance system design project.

KENMORE INTERCEPTOR SECTION 3

Kenmore Interceptor Section 3, the section of the interceptor between the Kenmore PS and the Kenmore Lakeline, receives flows pumped through the Kenmore PS, stored flows released from the Logboom Storage Pipes at the Logboom Regulator Station, and local flows from Northshore and Brier. The flow inputs are listed in Table 240-31.

Table 240-31. Modeling and Flow Inputs to the Kenmore Interceptor Section 3

Model Basin or Pipeline	Percentage of Total Basin Flow	Input Location	Notes
M_BRR001	100	MH W11-42	Flow from Brier through Northshore
M_NUD042	100	MH W11-42	Flow from Northshore

The local flows entering the pipeline vary from 6.6 mgd in 2010 to up to 8.3 mgd while the pipeline has a capacity of 29.7 mgd in the limiting section. The difference between the pipeline capacity and the local flows entering the pipeline would be available for the

Kenmore PS to divert flows away from the Brightwater Treatment System, assuming that capacity is available in the Kenmore Lakeline. The Brightwater Treatment System Environmental Impact Statement indicates between 2030 and 2050, local flows entering Kenmore Section 3 would be diverted into a new pipeline from MH W11-42 to the South Kenmore Portal of the Brightwater Influent Tunnel. After this pipeline is installed, the Kenmore Interceptor from MH W11-42 downstream to the connection with the McAleer Trunk at MH W11-35 would receive minimal flows. Provisions need to be made at the connection to provide flushing flows to the pipeline to prevent solids deposition and odor generation.

LYON CREEK TRUNK

The Lyon Creek Trunk receives flows from two model basins. The location of the flows and percentage of total basin flow are indicated in Table 240-30.

Table 240-32. Modeling and Flow Inputs to the Lyon Creek Trunk

Model Basin or Pipeline	Percentage of Total Basin Flow	Input Location	Notes
M_LYON021	100	MH 23	Flow from Snohomish County
M_MCALE004	9	MH 18	
	11	MH 11	
	29	MH 6	
	19	MH W502-38	
	8	MH W502-32	

Existing Capacity and Projected Future Flows

Figure 240-25 shows the capacity of the individual pipeline segments of the Lyon Creek Trunk as well as the projected future flows through the pipeline. Almost all of the pipeline will have adequate capacity to convey the 20-year peak hour storm through 2050. A 33-foot long section of 18-inch diameter pipe between MH W502-32 and MH W502-31 would have sufficient capacity in 2050. The location of the pipe is indicated in Figure 240-26. However, this section can convey the peak flow if the pipe is surcharged 0.1 feet above the crown of the pipe (a wastewater surface elevation 9.4 feet below the ground surface). Since this amount of surcharging is not anticipated to impact local connections to the Lyon Creek Trunk, no actions other than routine inspection and maintenance should be performed on this pipeline.

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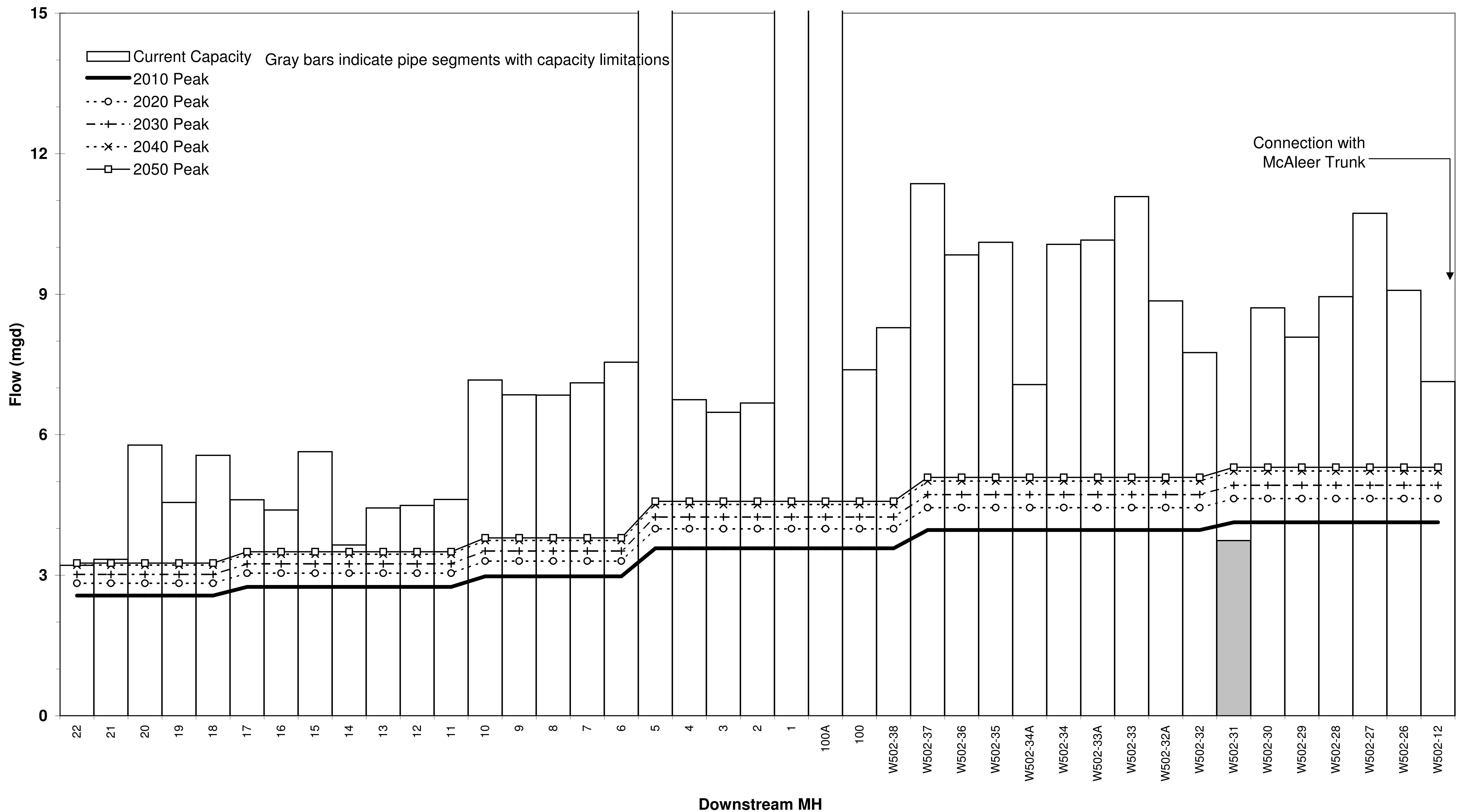

Figure 240-25. Existing Capacity and Projected Future Flows in the Lyon Creek Trunk

Figure 240-26. Limitations in Lyon Creek Trunk

LAKE BALLINGER PUMP STATION

All of the flows entering the Lake Ballinger PS come from four modeling basins, two of which roughly correspond to the Lake Ballinger – Snohomish Planning Basin identified in the Task 210 report. The other two modeling basins comprise the Lake Ballinger – King Planning Basin. The total flows to the pump station and the capacity of the station are shown in Figure 240-27. The figure also shows the projected flows if a 35 percent I/I reduction is achieved.

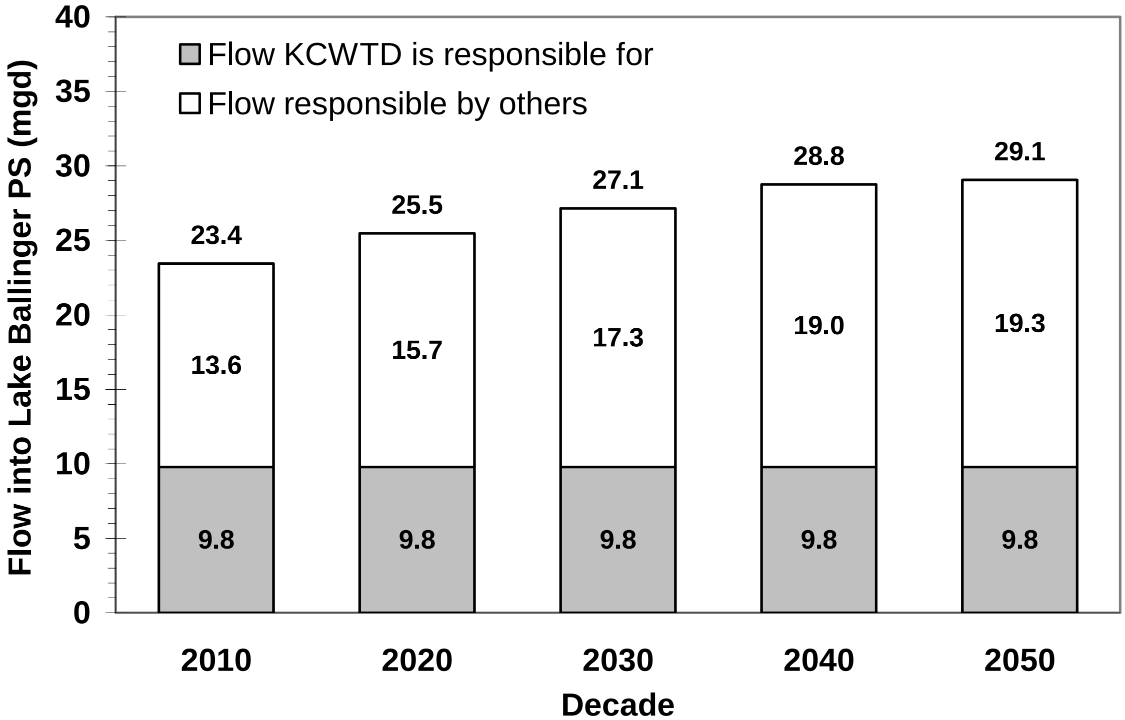

Figure 240-27. Projected Flows through Lake Ballinger Pump Station

The flow projections indicate that the peak capacity of the pump station and forcemains to convey flow to the Ballinger McAleer Trunk is much less than the flow entering the facility. However, the Edmonds Flow Transfer Agreement states that the County is required to accept and convey only up to 9.8 mgd of the flow. Because of this restricted flow requirement, the Lake Ballinger PS will have adequate capacity to convey the agreed-upon King County portion of the flow. It is therefore assumed that others will be responsible for conveying and treating the remaining peak flows, which will range from 13.6 mgd to 19.3 mgd from 2010 to 2050.

LAKE BALLINGER MCALEER TRUNK AND MCALEER TRUNK

The Lake Ballinger McAleer Trunk consists of the pipeline from Lake Ballinger PS Forcemain Discharge Structure at MH 52 to MH W502-30 while the McAleer Trunk is the pipeline from MH W502-30 to the connection to the Kenmore Lakeline in Lake Washington at MH W11-35. The pipeline conveys flows from the Lake Ballinger PS, the Lyon Creek Trunk, as well as local flows generated by LFP and the Ronald Sewer District. The inputs to the pipeline are listed in Table 240-33.

Table 240-33. Flow Inputs to the Lake Ballinger McAleer and McAleer Trunks

Model Basin or Pipeline	Percentage of Total Basin Flow	Input Location	Notes
Lake Ballinger PS FM	100	MH 52	Flow from the Lake Ballinger PS
M_MCALE025	16	MH 48	
	17	MH 33	
	9	MH 25	
	28	MH 19	
	4	MH GR 14	
	26	MH W502-25A	
Lyon Creek Trunk	100	MH W502-12	Flow from Lyon Creek Trunk
M_MCALE004	7	MH W502-19	
	17	W502-05A	
M_KENMR000	30	W502-01	

Existing Capacity and Projected Future Flows

Figure 240-28 shows the existing capacities and the projected future flows in both the Lake Ballinger McAleer and McAleer Trunks. As indicated earlier for the Lake Ballinger PS, this analysis assumed that the pump station would only convey 9.8 mgd of the peak flows from the Lake Ballinger – Snohomish and Lake Ballinger – King Planning Basins to the upper end of the Ballinger McAleer Trunk.

The analysis indicates that there are two short sections of pipe that would not have adequate capacity for the peak hour flow. The two sections are shown in Figure 240-29.

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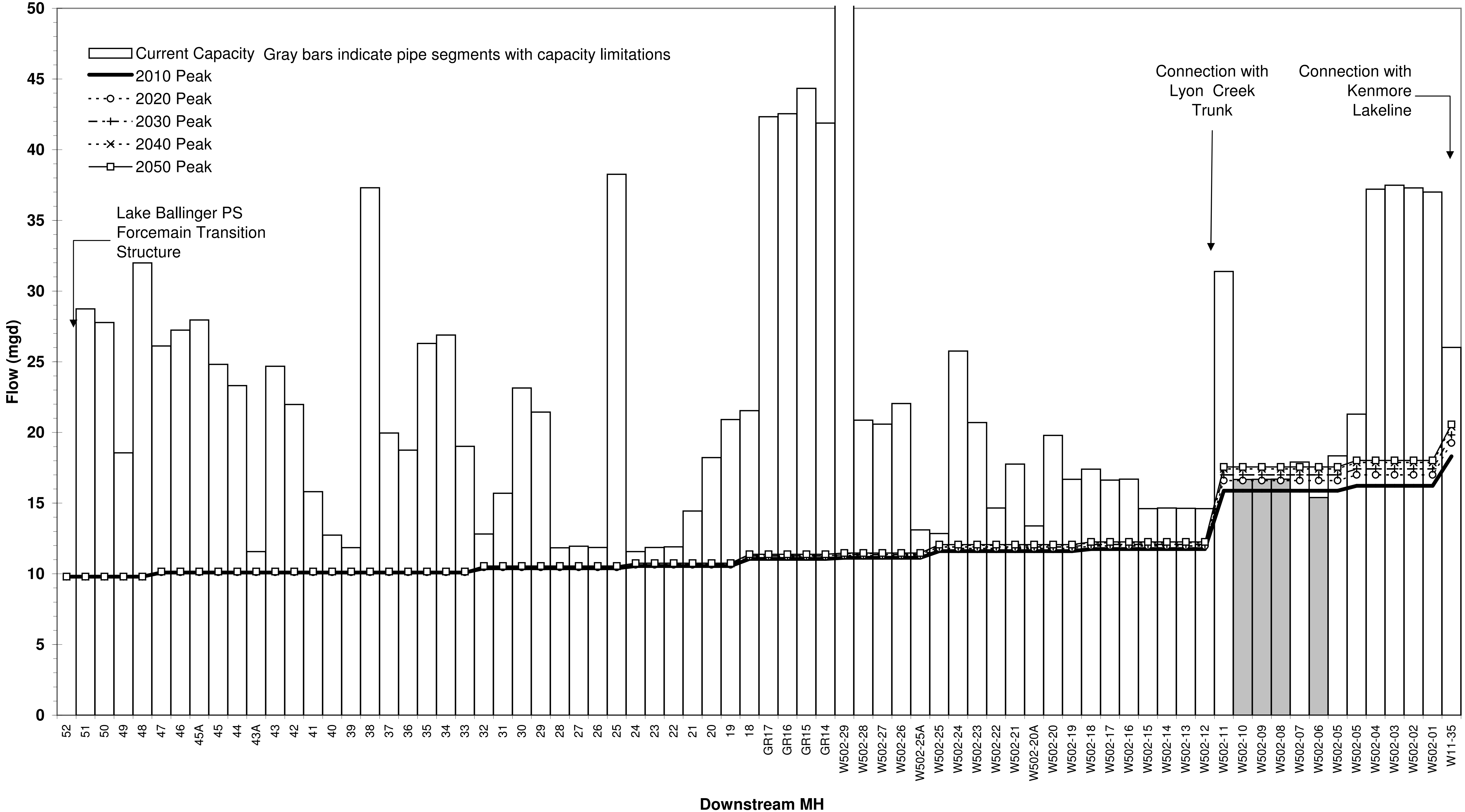

Figure 240-28. Existing Capacities and Projected Flows in the Ballinger McAleer and McAleer Trunks

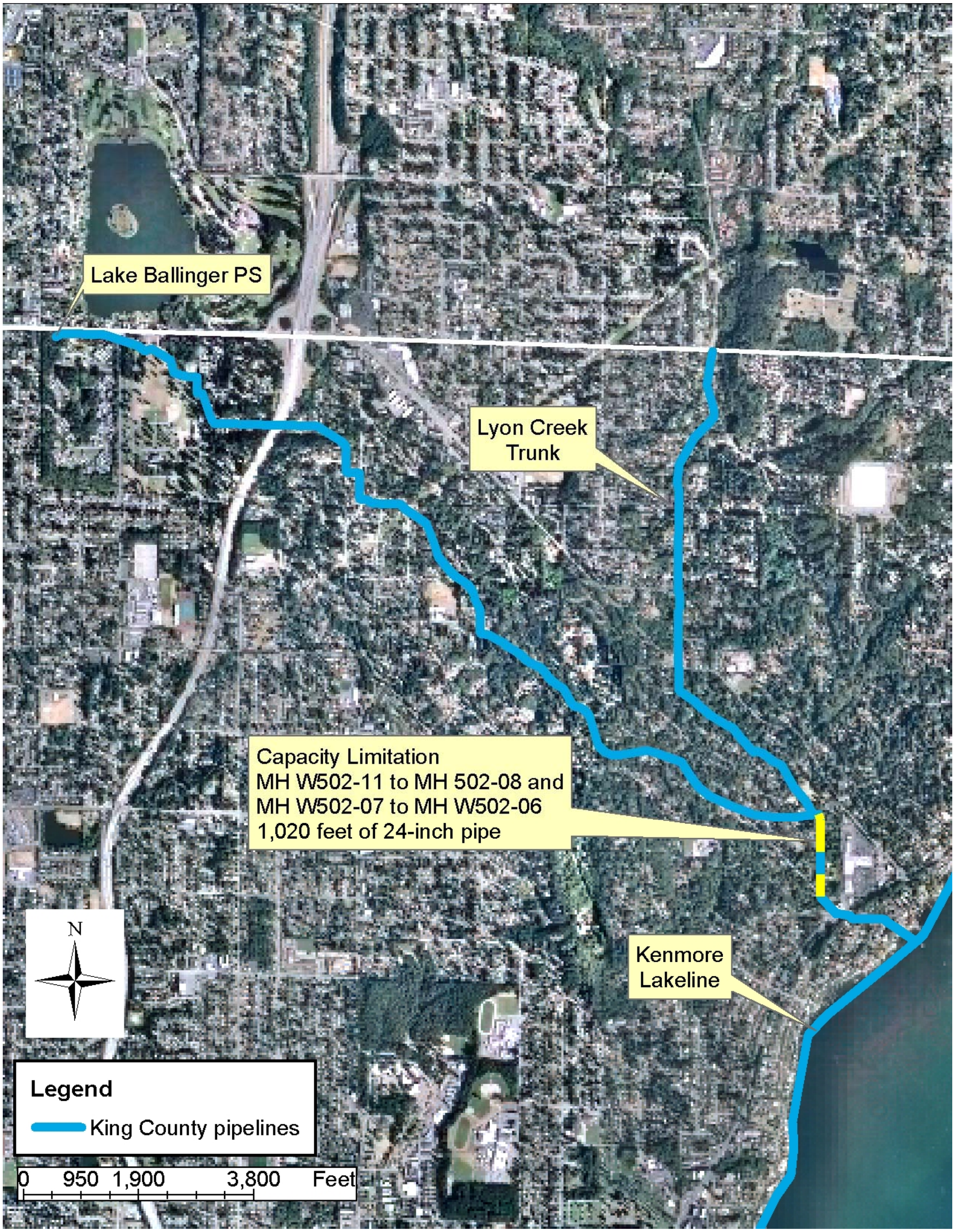

Figure 240-29. Capacity Limitations in Lake Ballinger McAleer and McAleer Trunks

The first section, MH W502-11 to MH W502-08, would reach capacity by shortly after 2020. Allowing the pipe to surcharge less than one foot over the crown of the pipe would provide enough head at the upstream end of the limitation to convey flows up to the 2050 peak hour flow. The second section from MH W502-07 to MH W502-06 would have its capacity exceed prior to 2010, but surcharging this pipe section by less than one foot would also allow the 2050 peak hour flow to be conveyed through the limitation. The inverts of both pipe sections are between 10 feet and 15 feet below the ground, so the impact of a one foot surcharge on the local system should be negligible.

CONCLUSIONS AND RECOMMENDATIONS

Table 240-34 lists the recommended improvements that need to be made to King County facilities in the North Lake Washington area and the year that the improvements need to be made. The most urgent improvements are for the sections of the North Creek Interceptor and Swamp Creek Trunk in Snohomish County. In both cases, improvements will need to be completed prior to 2010 to maintain King County's 20-year peak flow design standard. In addition, a restricted section of the Kenmore Interceptor Section 5 will need to be replaced by 2010 to allow full use of the planned Brightwater Safety Relief Facility.

This analysis did not indicate that the Kenmore and North Creek PS would require future improvements. However, both pump stations will be improved as part of the Brightwater project. Please refer to the Brightwater documentation for the nature of the respective pump station improvements.

Potential improvements on several King County pipelines will be deferred through 2050 by allowing water surcharging. In each instance, the maximum water surface elevation from the surcharging will be several feet below the ground surface and is estimated to have little to no impact on local connections.

Implementing a 35 percent I/I reduction in the North Creek – Snohomish and Swamp Creek – Snohomish Service Basins could delay the need for improvements on the respective pipelines by 5 to 15 years. A similar I/I reduction in the Hollywood PS Service Basins could eliminate the need for improvements in the Bothell-Woodinville Interceptor as well as reduce the potential future use of the York PS.

Table 240-34. Recommended Improvements in North Lake Washington Planning Area

Facility	Recommended Improvement	Year of Improvement	Notes
Little Bear Creek Trunk	None		
North Creek Interceptor	NC1-A – pipe replacement	Prior to 2010	Improvements for section from MH 76-1.41 to MH 76-1.35 and MH 76-1.03 to MH 76-1.02 are deferred by surcharging pipe by no more than 1.3 feet
	NC2-A – replace entire existing western parallel and construct new parallel. Abandon existing eastern parallel or transfer back to Alderwood	Western parallel – prior to 2010 New parallel – 2015	Implementing a 35 percent I/I reduction in area upstream of restriction can delay construction of new parallel to 2023 (Alternative NC2-B)
	NC3-A – a new pipe to Brightwater Influent Pump Station	2020	Improvement will be delayed to 2035 if Alternative NC2-B is used
North Creek PS	None for this project		PS will be improved as part of Brightwater project
Woodinville PS	None		No improvements in addition those already scheduled for the facility.
Bothell-Woodinville Interceptor	BW-A –pipe replacement in two sections	2020 and 2030	Hollywood PS operates at 15.5 mgd. I/I reduction in Hollywood PS basin eliminates need for improvement
Swamp Creek Trunk	SC1-B – new parallel	2010	Improvements for section from MH S1-90.A14 to MH S1-90.A13 and MH S1-90.A9 to MH S1-90.A7 are deferred by surcharging pipe by no more than 0.1 feet. New parallel can be delayed to 2015 with I/I reduction
Kenmore Section 5	Pipe replacement	2010	Improvement to allow for Brightwater Safety Relief Facility
Kenmore PS	None for this project		PS will be improved as part of Brightwater project
Kenmore Section 3	None		
Lyon Creek Trunk	None		Surcharging pipe by 0.1 feet will allow trunk to convey the 2050 peak hour flow
Lake Ballinger PS	None		
Lake Ballinger McAleer Trunk and McAleer Trunk	None		Surcharging pipe by less than 1 foot will allow trunks to convey the 2050 peak hour flow